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Some Feasible Long-Run Policy Alternatives for the Agricultural Sector in Bolivia

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SOME FEASIBLE LONG-RUN POLICY ALTERNATIVES FOR THE AGRICULTURAL SECTOR IN BOLIVIA

by

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ABSTRACT

Some Feasible Long-Run Policy Alternatives for the

Agricultural Sector in Bolivia

by

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The purpose of this paper is to construct a model that will aid in analyzing present agricultural policies along with feasible alternatives. Recently completed studies of production costs, crop prices and yields, and experimental technologies were used as sources of data. A linear programming model was used to project suggested investment for agriculture in land, labor, and capital inputs in order to achieve specific crop production targets. The paper is divided into four major parts: the theory of policy-making, the model description, the application of the model to Bolivia, and the results and conclusions, in that order.

(152 pages)

INTRODUCTION

The people of Bolivia, as in other countries, are caught up in what has been called the "rising tide of expectations". Part of these asperations are economic and exert pressure for efficient use of scarce resources. Historically, mining has been important and there is considerable potential for this sector to expand into petroleum production and processing. Nevertheless, most families' existence is tied to the land and for them, progress in agriculture is a prerequisite for a better life. Moreover for the nation as a whole, the agricultural sector must be able to release labor and generate sufficient quantities of food to create a solid base in order that other sectors may develop.

Bolivia has substantial untapped agricultural potential, but at the present time there is much dependence on food imports. Thus, there is a dual micro-macro economic problem. In this case, the problem consists of whether to use the comparative advantage it has in petroleum and minerals to import food or to increase domestic production of food to help the campesino attain a higher level of living. The government is faced with many alternative choices in setting policies to deal with this dilemma.

The main purpose of the study is to determine which policies will probably be most helpful in achieving the crop production targets (the policies most useful are the ones that accomplish the targets at least resource cost) and what effects alternative goals and policies will have on relative resource positions among the various agricultural zones of Bolivia. This would include the indentification of major input shifts that can be expected as technology changes.

One strategy that will be used in this study is the introduction of new technology into a linear programming model so that projected supply can keep pace with projected demand. The introduction of extensive irrigation, for example, may well cause factor movements both within and among regions. To make more relevant policies, the government needs to know the probable extent and nature of such changes.

The specific objectives of this study are: (1) to supplement a linear programming model so that it can suggest efficient resource allocation in achieving production targets given different levels of technology; (2) to estimate specific returns to certain technologies such as extensive irrigation (benefits of technology in achieving production targets); (3) to estimate the sensitivity of various "efficient" target achieving solutions when different mixtures of production targets and import-export policies are employed.

CHAPTER I

ECONOMIC POLICY

Economists have generally remained silent on the matter of setting public policies and have stayed within their realm of efficiency criterion. Usually, decisions concerning welfare, are left to the politician and public policy-makers. Many times, this has been the easy way out for the economist because he lacked the necessary tools to enter the debate. Though, when policies affect the efficient allocation of resources, then the economist can analyze the results and is able to suggest possible least-cost alternatives.

> If economists are to make the greatest contribution to policy formation, they must continually probe for a greater understanding of how the economy functions, why it functions as it does, and what the implications are for resource use and income distribution to various groups in society. This type of descriptive analysis is necessary to identify and to quantify relationships among economic establishment of norms for development. [1, p.54]*

Policies are made to obtain specific goals or targets. There are exogenous and endogenous variables that influence policy operation, some are controllable while others are not. The policy-makers can control the exogenous policy instruments at their discretion while, at the same time, they have no control over exogenous factors such as weather, crop

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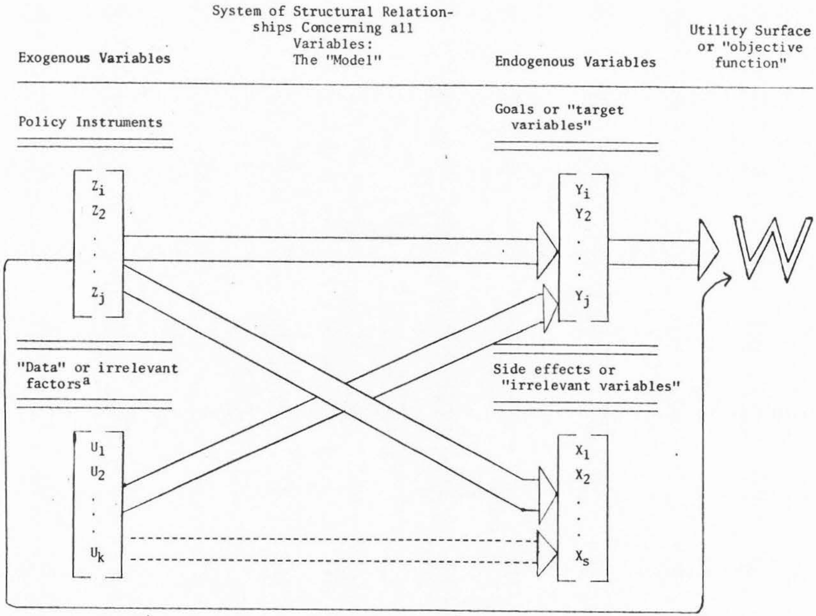
*Numbers in brackets refer to references in bibliography section.

production, population, international prices, and other factors that are outside of the system and not influenced by its operation but, in turn, have influence upon the system. The endogenous variables are those which influence the system and, in turn, are being influenced by the system. They include such items as national output, employment, prices, incomes, private expenditures, and national income [1, p.54, 2, p. 44]. Figure 1 illustrates the relationships that exist between the different variables.

The variables of the model are classified into four different types: 1) the "target" variables (y_i), which are to be purposefully (though indirectly) influenced by the policy-maker; 2) the "instrument" variables (z_j), which are the means available to the policy-maker; 3) the "data" (u_k), which are not subject to control by the policy-maker; and, 4) the "irrelevant" variables (x_s), which are the side effects in which the policy-maker is not interested [3, p.21].

The "target" variables are directly related to the community's welfare function which should be the objective of all modern economic policy. Examples of these variables could be national output, volume of employment, balance of payments' position, etc. The levels of the target variables that are desired by the policy-maker are called targets of economic policy [3, p.22]. For instance, a 10 percent increase in national output could be the overall target of the subtarget to increase agricultural production by 7 percent. These variables are the "knowns" to the policy-maker.

The "instruments" are directly under the command of the policy-maker and are used by him to attain the targets. Examples of these variables



[a] Not subject to control by the policy-maker or level of government that sets the goals and uses the policy instruments in question.

Source: [3, p.21].

Figure 1.1. The Theory of Economic Policy

are taxes, exchange rates, price supports, and import-export duties and quotas. When the policy-maker uses these variables, he is implimenting the instruments of economic policy, such as a 20 percent devaluation, a 10 percent increase in taxes, or a 50 percent import duty on certain consumer durables. The important decision in economic policy is the proper rate of change for these variables. Since there are many different levels, the policy-maker can set many different rates of change for any one instrument. However, the optimum level depends on the levels chosen for the targets. Consequently, the instrument values are the "unknowns" to the policy-maker [3, p.22].

The variables not under the control of the policy-maker such as crop production, population, and international prices are variables given to him as "data". The analysis of the data is very important and useful when making decisions of continuing or discarding certain policy instruments.

After specifying the target, instrument, and data variables, the remaining variables can be classified as "irrelevant" [4, p.4]. These variables are influenced by the instruments, and data could be gathered about them but, they, in turn for one reason or another, do not affect the total welfare function or policy objectives. They were excluded because of their irrelevance to policies under present consideration and by no means are they unimportant to the economy as a whole.

In addition to the target variables contained in the total welfare function (W), there may also be instrument variables. The importance of their effect may be understated by the smallness of the arrow in the chart leading from the z_j vector to W. However, shadow prices and/or direct monetary expenditures can be imputed in most cases for the instrument variables and may result as one of the major factors influencing the overall welfare function [3, p.22].

Economic policy can be a powerful tool in the hands of policy-makers. In order for it to be operational, three problems must be dealt with: fixation of the targets to be attained, indication to the policy-maker of efficient instruments of policy, and making available to him a simplified and manageable model to enable the calculations of the values to be assigned the instrument variables. In short, this process is to design targets and instruments, and construct a simplified decision model [4, p.XIII].

Implementing Policy

Optimal policy-making is much more complicated in practice than outlined above. When practical applications are made to actual economic systems, complications may arise: (a) because the equations defining the economic system may contain random or stochastic elements, (b) because there may be lags between actual control and the planned or potential control, where the latter may be subject to upper and lower limits for each time period [3, p.17], and (c) because, in long run planning, target variables could become instruments as the total welfare or preference function is changing through time. Targets would have to be visualized not as fixed constants, but as a certain function of time.

Within one or more of the interim periods of the planning horizon, unforeseen random variables may affect the system making it necessary for some short-run adaptations. For example, weather may prevent production of the agricultural sector from reaching its production target. Adjustments may be necessary in import-export instruments or even in tax instruments to restore equilibrium. These changes can only be applied if the targets are well-defined and the instruments are applied in a coordinated fashion. This requires the continuous and orderly study of various alternative economic policies.

If there is a shortcoming of having such an explicit model, it would have to be a misconception about economic policy or the belief that there is a one-to-one correspondence between the instruments and targets; that is, that each instrument, or group of instruments, has to serve one special target. Public policy-makers may underestimate or ignore the fact that simultaneous interrelationships among the targets and the instruments exist [4, p.XII]. This may explain why policies are often executed in an uncoordinated manner.

Altering certain instruments aimed at one target may necessitate changes in other instruments aimed at other targets. When the cycle of changes is complete, the policy-maker acting in isolation, may realize that the changes made in the original instruments were not optimal. Further changes are required to assign optimum values to the instruments in order that the system approaches equilibrium and a trial and error method of policy-making results. The fact that interrelationships do exist suggests the need for well-defined statistical knowledge of the instruments and targets in order to create the capability of making better quantitative selections, rather than arbitrary qualitative selections, so equilibrium can be restored by a more systematic policy.

Collection of systematic statistical data is important not only for present planning, but also for prediction of optimal policy performance in future planning. When instruments are varied in the execution of interim as well as long range policy adjustments, basic shifts must occur in the fundamental economic order of the system. These changes may not be drastic but still, they involve some kind of switchover. Relaxation of certain import duties may allow the farmer to switchover from one type of production to another. In lesser developed countries, this may be the change from traditional to semitraditional agriculture. By systematically varying the different instruments, the policy-maker can establish a method of evolutionary (nonstationary) control techniques [3, p.33].

The implimentation of these control techniques requires that data be collected in some systematic form so that fixed intervals or phases of production can be established. We assume that the farmer cannot alter his method of production within the phase but may change between phases. The policy-maker has the desired level of the welfare function (W) as given, as well as the statistical data collected in the previous and present phases. We denote the instruments used in the present or k^{th} phase by $z(k)$. The objective is to control the change in the variables from $z(k)$ to $z(k+1)$ in order to minimize the cost of the switchover or maximize the returns to the welfare function during the $(k+1)^{th}$ phase. The planner can estimate the optimum value of the instrument vector in the $(k+1)^{th}$ phase subject to the criteria of (W) and then set $z(k+1)$ equal to it. Use of present and predicted data is necessary to quantify these future values which, in essence, makes it a problem of efficient prediction more than anything else [3, p.33].

The ideal model uses only the controllable variables and delimits the rest. This, in a sense, aims policy instruments directly at certain targets which make up part of the total objective function. In the real world, the noncontrollable exogenous variables enter at this point and also affect the targets. The economist can analyze the noncontrollable factors (data) and at this juncture he has something to say about policy costs, efficient allocation of resources and their effect on total welfare.

Policies can be a means to an end, the end being the fulfillment of a projected production target or political goal. A policy is formulated in many ways. In Bolivia, for example, policies are set by statistical projections, official consensus of a government agency, the lone crusade of a particular government official, outright guesses, and many more methodical and "seat-of-the-pants" processes. Whatever the process, many production targets and policies have been formulated.

The numerous targets, whether announced or inferred, are valuable to this study for the following reasons. First, from the assortment of official and unofficial documents, it is possible to deduce the general direction of present and future development policy. Second, the role that new technologies might play can be determined with regard to accomplishing the targets and formulating new policies. Third, the presence of supply/demand projections of certain agricultural commodities opens an area of alternatives to present policies and targets. The grounds for determining the parameters of the range of alternatives might be based upon the following rationale.

In the future, projected supply will either equal or not equal projected demand. When the projected quantities are not equal, supply can either be in surplus or deficit. If in surplus, one available option is to sell it abroad. If it can be sold, how much is desirable to export? The policy implications may involve setting an export target or formulation of an export policy encouraging more exports of that particular commodity. When selling the surplus is not desired or is not possible due to international controls or domestic reasons, a contractionary production policy is needed. A cutback in production would occur until some target or goal is obtained.

In the case of a projected supply deficit, either increased imports or increased domestic production are the alternatives. In choosing the option of importing, the policy might be to import the good as long as the cost of importation is less than that of producing it domestically. When importing is undesirable because of political, monetary, or relative cost implications, and satisfaction of projected demand is desirable, there must be a domestic expansionary policy.

In less developed countries, it is especially important that policies direct resources to beneficial activities. Misdirection results in loss of time and wastes scarce developmental resources. Agriculture has many of the basic resources that are essential to the process of development but, much too often, this sector is neglected.

CHAPTER II

MODEL

A linear programming model will be used in the analysis of policy alternatives. This model was chosen because allocation of resources are easily manipulated by the program. The purposes of the LP model are to determine optimum allocation of resources that minimize cost of achieving a given production level and to assess the aggregate effect of individual adjustments as well as determine further adjustments needed at the farm level to coincide with aggregate demand and supply conditions.

The process of linear programming deals with obtaining optimal solutions through an iterative process. Each step leads to a higher profit or lower cost (depending on the nature of the problem) until an optimal solution is reached. This may appear as a panacea to problems of profit maximization or cost minimization. Unfortunately, the model is confined by certain conditions and assumptions.

The first condition is that of "fixed proportions". Increasing or decreasing returns to scale is ruled out by this assumption. If, for example, the proportion of labor to land equals two and capital to labor equals three, the LP model assumes these ratios to be fixed.

The second condition assumes "constant returns to scale". This implies that if the inputs are doubled, two units of output are produced. No allowance is made for the possibility that increasing one input by k+1 while only increasing the remaining inputs by k might result in k+1 units of output. All units must be increased by k+1 in order to satisfy requirements of the LP model. The additional increases in unnecessary inputs essentially are wasted resources due to the assumption of constant returns to scale.

The third assumption is "independence". This condition means that the activities are not dependent on one another. Changes in one activity does not necessitate changes in other activities and have no effect upon them. Clarification should be made that while the activities are independent, they may also be mutually exclusive.

The three conditions of fixed proportions, constant returns to scale, and independence give rise to the word linear in linear programming because they lead to linearity. "Linearity means that we can formulate the process of production by adding as many units of X to as many units of Y, without squaring X, or taking logarithums." [6, p.332]

The final condition is "divisibility". This allows the firm or producing process to produce fractional units. Of course, the inputs are fractional units also due to the first three assumptions. The firm is free to employ numerous activities or processes to produce a certain output. As an illustration, the firm may employ processes X producing 2 3 units, Y producing 3.1 units, and Z producing 5.4 units to obtain a total product of 10.8 units. In certain cases though, divisibility is not appropriate and therefore the assumption can be relaxed without affecting the validity of the program.

An Example

A graphical example may help to illustrate how LP models arrive at the optimal solution. Consider a least-cost problem. Suppose that two technologies and three inputs are available. In producing sugar cane, a farmer can use the traditional or semitraditional technologies. The following equations represent the amounts of each input available and how much is used by each technology.

$$2X + 3Y \geq 18 \qquad \text{(labor)}$$
$$2X + Y \geq 8 \qquad \text{(capital)}$$
$$X + 3Y \geq 12 \qquad \text{(land)}$$

X is the traditional technology represented by the vector containing 2X, 2X, X. Y is the semitraditional technology represented by the vector containing 3Y, Y, 3Y. The inputs are land, labor, and capital. The minimum supply available of inputs is represented by the vector containing 18, 8, and 12. The farmer wants to know the least-cost method of using the available resources when he has already committed certain amounts of inputs to production. The problem is to minimize the "objective function". Cost is represented by C and the function is:

$$C = 5X + 7Y \qquad \text{(objective function)}$$

The objective function is not only subject to the above mentioned constraints of available resources and combinations of inputs, but, also $X \geq 0$ and $Y \geq 0$. This ensures that they are used only at positive levels. Figure 2.1 shows the relationships.

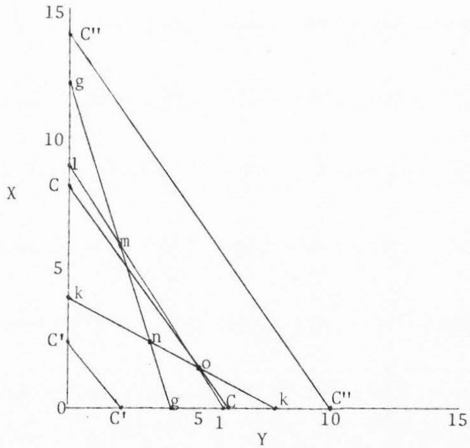


Figure 2.1. Cost Minimization Without Target Restriction

The line ll represents the inequality $2X + 3Y \geq 18$, kk represents $2x + Y \geq 8$, and gg represents $X + 3Y \geq 12$. The boundary of the feasible region is the line gmok and the area to the right (including the boundary line) represents the total feasible region where solutions to the problem can be found without violating any constraint. Logically, the "optimal" least-cost solution is some point on the line gmok. The LP model located the optimal point in the following theoretical procedure.

Setting the objective function or cost equal to 14, 42, and 70, respectively, we have the iso-cost lines of CC, C'C', and C"C". There are an infinite number of iso-cost lines but to simplify the graph only three are represented. The LP program selects different iso-cost lines until one is found to be tangent with the feasible region. The simplex method is the process of iterations that lead to the optimal solution in which the program procedes in definite steps choosing only a step that represents a lower cost than the previous step until a point of tangency is reached similar to point 0 in Figure 2.1. The farmer should use 1.4X and 5Y.

The additional restriction of meeting the target changes the whole complexion of the model. The objective function now tries to minimize the cost of reaching the target. The equations are:

$$\begin{aligned} 2X + 3Y &\leq 18 \quad &\text{(labor)} \\ 2X + Y &\leq 8 \quad &\text{(capital)} \\ X + 3Y &\leq 12 \quad &\text{(land)} \\ X + 2Y &= 8 \quad &\text{(target)} \end{aligned}$$

The lines ll, kk, and gg are the same as in Figure 2.1. Assuming that the farmer only wants to produce 8 units of output, he wants to know the mixture of available technologies that would minimize costs. The target assumption confines the solution to the area left of and including the boundary line lmnol. The target is represented by line tt [Figure 2.2].

The most obvious least-cost solution is to use technology Y and produce the entire 8 units at a cost of $28. Assume that present circumstances do not allow the farmer to make the complete transformation because $10 has already been committed to technology X. In view of these restrictions, line CC minimizes the cost at $31. Complete change over to technology Y will minimize costs in the long run.

The highest achievable target is 8.9 units unless more inputs become available. Land (line gg) is the constraining factor. If expansion is desirable, investments to develop land should receive top priority up to the point where labor becomes the constraining input. Introduction of

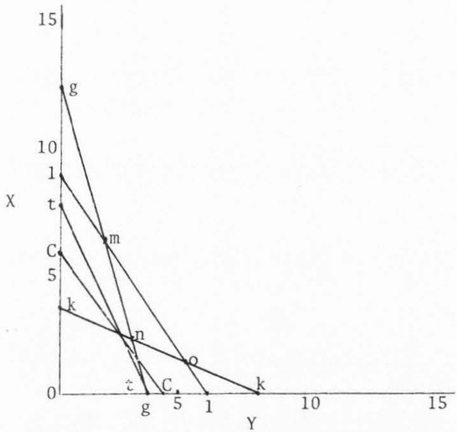


Figure 2.2. Cost Minimization With Target Restriction

targets into an LP model allow policy-makers to, (a) see the cost of such actions, (b) to be able to rank investment priorities, and (c) observe the direction in which marginal rate of transformation should occur. The decision-making process becomes more complicated when one considers three or more technologies whose costs and yields are closer together than those in the example. The least-cost point becomes a peak in a multidimensional plain.

Model Used in Study

The LP model used in the study will attempt to minimize the resource cost of accomplishing prescribed national production targets. In terms of the program, the total value of resource costs is the objective function, and the economic constraints are related to the technical feasibility of production and become the production function. For example, if an input vector of resources is designated as P and an associated production target or output is designated as T, then the problem is to minimize an objective function g(P,T) subject to the constraint f(P,T), which is better known as the b_i vector or "right hand side" (RHS).

The solution of optimality for g(P,T) implies certain relationships between the inputs and outputs. Using calculus to find a minimum, we differentiate the objective function with respect to each of the vector components, setting each differential equal to zero and solving for the unknown. At this point, the problem is overdetermined. To compensate, artificial unknowns called Lagrange multipliers are introduced. These variables are weights which multiply the difference between the derived cost in each year period q from a unit increase in the quantity of the i^{th} input and the marginal charge that is actually paid in period q. Thus, the Lagrange multiplier λ can be interpreted as the marginal opportunity cost, or shadow price, of redistribution in terms of efficiency. In equation form:

$$MVP_{(x_i)} - MK_{(x_i)} = \lambda MI_{(x_i)} \qquad \text{(a)}$$

and $$\lambda = \frac{MVP_{(x_i)} - MK_{(x_i)}}{MI_{(x_i)}} \qquad \text{(b)}$$

where MVP = marginal value product,
MK = marginal cost,
MI = marginal net redistribution gain,
x_i = input i [8, p.77].

In equation b, λ is a weight which is the value of the ratio of the marginal efficiency gain, $MVP_{(x_i)} - MK_{(x_i)}$, to the marginal net redistribution gain. Where more than one period is considered, λ is the gain in efficiency in terms of present value of net marginal efficiency gains incurred by the last peso of net cost allocated to redistribution of resources in that particular time period.

The resulting relationships between the inputs and outputs and their respective prices is:

$$\frac{\partial u/\partial Xi}{\partial u/\partial Yj} = - \frac{\partial Yj}{\partial Xi} = \frac{Pi}{Pj} = MPP \quad . \ . \ . \ . \ . \ . \ . \quad (1)$$

$$\frac{\partial u/\partial Xi}{\partial u/\partial Xh} = - \frac{\partial Xh}{\partial Xi} = \frac{Pi}{Ph} = MRS \quad . \ . \ . \ . \ . \ . \ . \quad (2)$$

$$\frac{\partial u/\partial Yj}{\partial u/\partial Yk} = \frac{\partial Yk}{\partial Yj} = \frac{Pj}{Pk} = MRT \quad . \ . \ . \ . \ . \ . \ . \quad (3)$$

[8, p.102-103].

Further interpretation of these equations clearly express the different relationships:

$\partial u/\partial Xi$ = marginal cost of input i = price of input i = P_i,

$\partial u/\partial Yj$ = marginal benefit of output j = price of output j = P_j,

$-\partial Yj/\partial Xi$ = marginal physical product (MPP), the additional output which can be produced per unit of input,

$-\partial Xh/\partial Xi$ = marginal rate of substitution (MRS), the marginal rate at which the h^{th} input can be substituted for the i^{th} input while holding production constant,

$-\partial Yk/\partial Yj$ = marginal rate of transformation (MRT), the marginal rate at which production can be shifted from the j^{th} output to the k^{th} output.

The three equations may be rewritten in a more straightforward fashion using economic terms:

$$MC_i/MB_j = MPP_{i_j} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$MC_i/MC_h = MRS_{h_i} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$MB_j/MB_k = MRT_{j_k} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$ [8, p.103].

In summation, to have a condition of optimality of g(P,T) subject to f(P,T), the following rules apply:

> Rule 1. The optimum allocation of goods. Each consumer maximizes his satisfaction by ordering his consumption so that the marginal rate of distribution between any two goods is equal to the ratio of their prices....
>
> Rule 2. The optimum degree of specialization. Each firm maximizes its profit by making its marginal rate of transformation between any two outputs produced equal to the ratio of their prices....(Equation 3)
>
> Rule 3. The optimum relationship between input and output. Each firm maximizes its profit by equating the marginal physical product of input in producing output with the ratio of their prices....(Equation 1)
>
> Rule 4. The optimum allocation of inputs. Each firm maximizes its profit (minimizes its cost) by making its marginal rate of substitution between any two inputs used in production equal to the ratio of their prices....(Equation 2) [9, p.103].

Pure competition automatically achieves these optimum conditions. This is a problem in linear economics since the restrictions on the problem are linear because the total amount of any resource allocated to all production techniques must not exceed the total amount available, thus each restriction is a simple sum [7, p.12].

The specific model of the study is to:

$$\text{minimize} \quad \sum_{i=1}^{m} \sum_{j=1}^{m} \sum_{k=1}^{m} C_{ijk} X_{ijk}$$

subject to: $$\sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{k=1}^{o} A_{ijk1}X_{ijk} \le b_{1k}[(i=1,2,\ldots,m),\ (i=1,2,\ldots,n),\ (k=1,2,\ldots,o)]$$

$$\sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{k=1}^{o} A_{ijk2}X_{ijk} \le b_{2k}[(i=1,2,\ldots,m),\ (j=1,2,\ldots,n),\ (k=1,2,\ldots,o)]$$

$$\sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{k=1}^{o} A_{ijk3}X_{ijk} \le b_{3k}[(i=1,2,\ldots,m),\ (j=1,2,\ldots,n),\ (k=1,2,\ldots,0)]$$

$$\sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{k=1}^{o} A_{ijk4}X_{ijk} \le b_{4k}[(i=1,2,\ldots,m),\ (j=1,2,\ldots,n),\ (k=1,2,\ldots,o)]$$

$$\sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{k=1}^{o} A_{ijk5}X_{ijk} \le b_{5k}[(i=1,2,\ldots,m),\ (j=1,2,\ldots,n),\ (k=1,2,\ldots,o)]$$

and X_{ijk}, C_{ijk}, A_{ijk1}, $b_{ik} \ge 0$.

where: C_{ijk} = cost in pesos per hectare of the i^{th} crop produced in the j^{th} technology in the k^{th} zone.

X_{ijk} = hectares of the i^{th} crop produced in the j^{th} technology in the k^{th} zone.

A_{ijk1} = cost in pesos of input 1 per hectare of the i^{th} crop produced in the j^{th} technology in the k^{th} zone.

b_{ik} = total amount of input i available in the k^{th} zone.
b_{1k} = available land in the k^{th} zone.
b_{2k} = available labor in the k^{th} zone.
b_{3k} = available capital in the k^{th} zone.
b_{4k} = available water in the k^{th} zone.
b_{5k} = available fertilizer in the k^{th} zone.

Dual Problem

Every linear programming problem has a corresponding problem called its "dual"; the original problem is called the "primal" problem. If the primal is a maximization problem, the dual is a minimization problem; if the primal is a minimization problem, the dual is a maximization problem. The solutions to the dual are "shadow prices". The dual function is to (a) allocate scarce resources, and (b) attach values to the different resources used. The computer program prints out the activity level (the solution to the allocation of resources) and under the heading "Dual Activity", a value is attached to the resources used. In economic terms, these values are the marginal value products. They indicate the change that would occur in the objective function for each unit change of resource input.

The program arrives at the various shadow prices through the following logic. Suppose the shadow price of $Land_{21}$ (land type 2 in zone 1) is to be calculated. The optimal solution is reached and the total cost is figured. Now, one less unit of $Land_{21}$ is used and a new total cost is found. The change in the total cost function attributed to using one less unit is the cost (value) of $Land_{21}$. Putting the above explanation into a simple formula we have:

$$\frac{TC' - TC}{(U-1) - U} = \text{shadow price}$$

where TC' = total cost of using one less unit,

TC = total cost at optimality,

U = units of resource used [6, p.336].

Using actual figures from the program we obtain the shadow price for $Land_{21}$.

$$\frac{\$b.3,531,999,437 - \$b.3,532,000,000}{10474 - 10475} = \$b.563$$

The shadow price can also help to construct a supply curve for each resource. If other resource values are held constant, the price of a particular resource can be varied from zero to a maximum amount. A series of shadow prices are generated and a supply curve can be inferred from this information.

Post-Optimal Procedures

Once the optimal solution is reached, post-optimal procedures exist that allow variations in the basis of the program. Parametric and sensitivity analyses are the two most common and both will be used in this study.

Parametric analysis is a procedure that allows step increases or decreases in values or quantities of specified variables to be performed. Usually, prices are changed by a fixed percentage per step. In this study, parametric programming will be confined to sequential changes in traditional technologies and target variables. The total variable cost of traditional technologies will be allowed to decrease by fixed percentages. This is desired in order to investigate the levels (cost) at which traditional technologies are able to compete with the more advanced technologies.

The target rows will be allowed to increase and decrease by prespecified increments to observe the changes that occur in the allocation of resources. The amounts of additional resources required at different stages will also be studied.

Practical problems in the linear programming framework are seldom completely "solved" by the optimal solution indicated in the model. Most of the coefficients (objective function coefficients, matrix coefficients, and right hand side coefficients) of the program have a certain degree of uncertainty attached to them. Linear relationships assumed for the present problem may not hold for the range indicated by the model solution. Therefore, it is often desirable to conduct a sensitivity analysis to determine the effect that changes in various coefficients have on the optimal solution. If the analysis reveals that the optimal solution is very sensitive to small changes of certain coefficients, care should be taken in checking their respective values. The sensitivity analysis identifies the coefficients that are critical to the program solution thereby reducing the number of coefficients to be re-examined.

CHAPTER III

APPLICATION OF MODEL TO BOLIVIA

General Characteristics

The country of Bolivia has interesting geographical features. Its altitude ranges from a high of 21,391 feet to a low of 361 feet above sea level [21]. The backbone of the Andes Mountains occupies most of the western half. Extending eastward, the terrain becomes less rugged until one has descended into dense tropical jungles and rain forests.

There are nine political departments: La Paz, Oruro, Potosí, Tarija, Chuquisaca, Cochabamba, Beni, Pando, and Santa Cruz. Sucre and La Paz are the capital cities with most of the government offices located in La Paz.

The people are mainly of two classes. There are the white descendents of the Spanish and the browner American descendents. The Indian race and mestizos account for 70 percent to 80 percent of all Bolivians. Two major Indian tribes still exist which are the Quechua and the Aymara. The Quechua tribe is mainly located in the Departments of Cochabamba, Oruro, Potosí, Chuquisaca, and Tarija, while the Aymaras are concentrated in the Department of La Paz and around Lake Titicaca. Three major languages are spoken with Spanish being the foremost. Quechua and Aymara are also spoken by large numbers of people. A knowledge of two and sometimes three languages is necessary to communicate with a major part of the people, consequently, many Bolivians are bilingual while some are even trilingual. In addition, there are many smaller tribes that inhabit the unexplored dense jungles of the interior which speak their appropriate dialects.

Bolivia is a landlocked country with no seaports. However, Bolivian railways do link the country to the sea through ports of other nations. The railroad network, though antiquated, incorporates most of the regions into the transportation system except areas such as the Beni and Pando where construction is very difficult. Making and maintaining roads is a difficult task. In 1971, the country had only 1,104 kilometers of paved roads which is less than 4 percent of all roads. Graded or graveled roads made up 11,486 kilometers (41 percent) and dirt roads totaled 15,529 kilometers (55 percent) [5, p.19].

World Position of Bolivian Agriculture

Agricultural exports have been a small percentage of total Bolivian exports. In 1972, they accounted for only 9.8 percent of all exports, a value of US$17.9 million. On the positive side, this percentage seems to be growing every year [Appendix B, Table B.1]. In 1970, agricultural exports increased 33 percent, while 1971 had an 80 percent increase, and 1972 resulted in a 40 percent gain over 1971 [13].

One of the major reasons for the sudden growth of agricultural exports is due to improved marketing conditions of coffee, beef, cotton, and sugar. Coffee was exported in small quantities until the early 1960's. Production increased rapidly due to the completion of all-weather access roads into the Yungas in Zone 7, consequently, exports have been growing.

The recent jump in the world price of beef has caused increased exports of this commodity. Major exports were begun in 1970. Presently, favorable prices are causing producers to sell important breeding stock, thereby reducing domestic production and consumption. Long run hopes are for an overall increase in the production of beef. World cotton prices have soared and this explains the rise in exports from a value of less than US$500 in 1965 to US$7.5 million in 1972. Considered alone, cotton was 30 percent of total agricultural exports in 1972. Large exports of sugar first occurred in 1965. The completion of paved highways and excellent secondary roads along with the building of larger sugar mills have made possible large scale production [13].

The period 1970-72 showed these four commodities accounting for 66 percent of all agricultural exports. The apparent comparative advantages of these crops were even more favorable in recent years for two reasons. First, world prices, due to increased world demand, have risen causing production to increase. Second, improvements in the infrastructure serving many producing areas have brought producer and exporter closer together.

Importation of agricultural products amounted to about 25 percent of total imports in 1971, a value of US$42.4 million [Appendix B, Tables B.3, B,4, B.5, B.6]. Agricultural imports appear to be declining over the long run. Major food imports are wheat and flour. Comparative disadvantages in wheat and flour had somewhat lessened due to recent changes in world prices. The savings in foreign exchange generated by reaching self-sufficiency in beef (1958), rice (1963), sugar (1964), and cotton (1969) is estimated to be US$15.6 million a year [13]. Bolivia is still a definite importer of agricultural goods [Appendix B, Table B.7]. Various self-sufficiency programs have been established by the Ministry of Agriculture in the hope of generating even larger foreign exchange savings.

Domestic Position of Bolivian Agriculture

Bolivia is a lesser-developed country where agriculture could provide the key to development. Presently, about 65 percent of the population is rural with many urban people also associated directly with agriculture. This compares to the surrounding countries as having the highest percent of rural population. Paraguay has about 63 percent, Ecuador 60 percent, and Perú 47 percent. The important statistic according to present trends, is that the urban population of Bolivia is increasing annually at 2.4 percent while Paraguay, Ecuador, and Perú have annual increases of 3.1 percent, 3.4 percent, and 3.1 percent, respectively [5, p.5].

Agriculture is the origin of 16 percent of the domestically produced national product in Bolivia. This is the largest percentage contribution of all sectors in the economy. Ironically though, the annual percent increase in production of .8 percent is the lowest of all recorded sectors and indicates that agriculture is losing ground. Comparing the percentage growth with Paraguay, Ecuador, and Perú which have agricultural production growth rates of 2.6 percent, 3.6 percent, and 1.0 percent, in that order, Bolivia has the lowest amount of yearly increase in production [5, p.8].

The Ministry of Agriculture has recognized that even though most of agriculture could be classified as "traditional", there are areas that are in the process of accelerating their rate of development. Agencies and commissions have been set up to specifically encourage and promote more rapid development of these sectors. One result has been that five-year plans for agricultural production were formed. More recently, the National Wheat Institute (Instituto Nacional de Trigo) was established to stimulate production of wheat to the point of self-sufficiency. Often agencies have been established separately. Frequently, the intent of their actions has almost been offset due to the interrelationships existing in the sector as a whole. Little study has been given to the effectiveness of the different agencies or the compatibility of their goals. Coordination of the different agencies and their actions would be a major step toward accelerating development in agriculture. This is quite beyond the scope of this study but an important application contained in the study would help the different agencies to be able to envision the different actions required that would accomplish certain national goals and coordinate their efforts more effectively.

Production Zones

Bolivia is divided into ten geographical zones for purposes of this study. The overall intention in doing this is to define regions that are as homogeneous as possible [Fig. 3.1].

Zone 1 is called Amazónica. It extends the farthest north and includes the Provinces of Iturralde (La Paz), Madre de Dios, Manuripi, N. Suárez, G. Roman, Abuna (Pando), Itenez, Mamore, and Vaca Diez (Beni). The total estimated area is 184,358 square kilometers (18,435,800 hectares). Population figures for 1972 estimates the number of inhabitants to be 115,722 which is 2.5 percent of the nation's total. The

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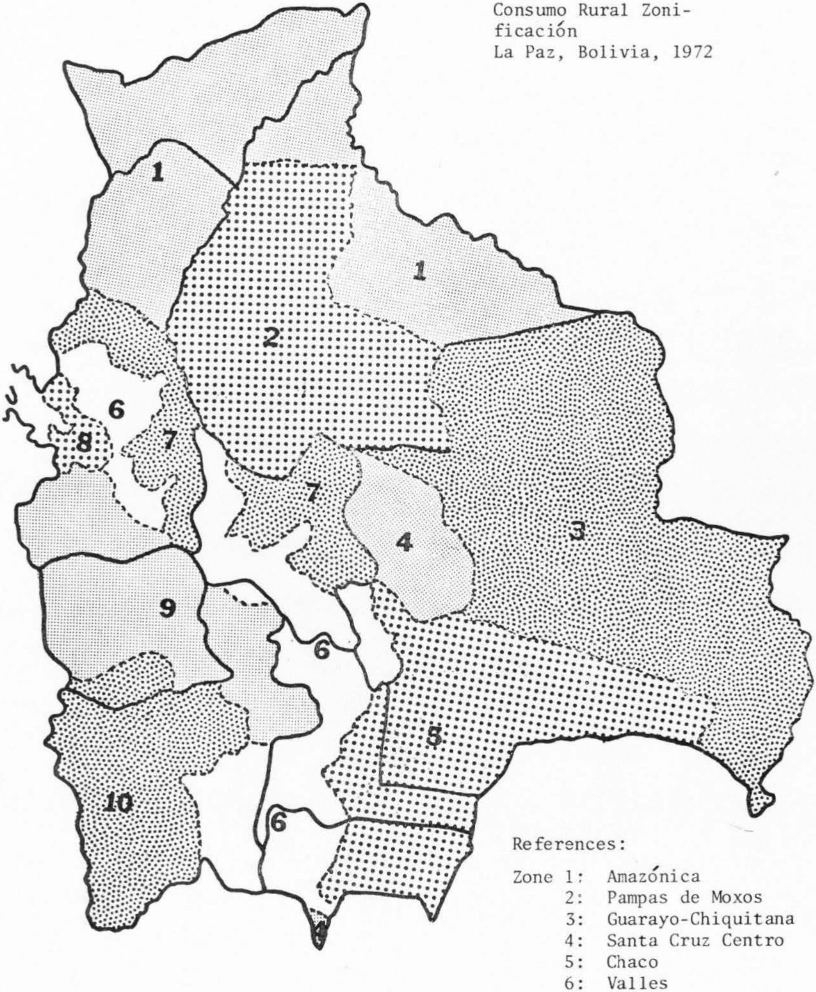
La Paz, Bolivia, 1972



References:

Zone 1: Amazónica
2: Pampas de Moxos
3: Guarayo-Chiquitana
4: Santa Cruz Centro
5: Chaco
6: Valles
7: Yungas
8: Altiplano Norte
9: Altiplano Centro
10: Altiplano Sud

Figure 3.1. Geographical Zones of Bolivia

climate can be considered as tropical with 1800 mm. (71 inches) of annual rainfall. The temperature has an annual average of 26°C (79°F) [11]. Needless to say there is heavy jungle. The infrastructure of this zone is comprised of footpaths and rivers that are partially navigable. Most long-distance transportation is accomplished by airplane. In the rainy season, this is virtually the only means of travel when considering any appreciable distance [Refer to Fig. 3.2].

Zone 2 is called Pampas de Moxos. The provinces that constitute this zone are all located in the Beni Department and are Marban, Moxos, Cercado, Yacuma, and Ballivian. The area is estimated to be about 135,848 square kilometers (13,584,800 hectares). The population is around 100,760 people which is 2.2 percent of the total. The climate is tropical but with less rainfall than zone 1. There are some jungles and heavily wooded areas. The terrain of zone 2 is distinguishable from that of zone 1 by the increased frequency of clearings or open spaces. Again, there are no major roads due to the many rivers and harsh rainy seasons of the area [See Fig. 3.2]. Currently, major commercial transportation is performed by airplane.

Zone 3 is named Chiquitana. It extends the farthest east and borders on Brazil and Paraguay. It is composed of the Provinces of N. Chavez, Velasco, Chiquitos, and N. Sandoval, all in the Santa Cruz Department. The estimated area is 240,693 square kilometers (24,069,300 hectares) and the population is 91,784 residents accounting for 2 percent of the total. The climate is subtropical with well-defined winters of dry weather and summers that are hot and humid. This is the largest zone because of its vast area of woods and plains. Transportation is

Source: [22].

Figure 3.2. Republic of Bolivia

somewhat easier with many secondary roads traversing the zone. A major railway extends from Santa Cruz to the city of Corumba at the Brazilian border [See Fig. 3.2].

Zone 4 is Santa Cruz Centro. This is the second smallest zone but one of the most productive of diversified agricultural products. The area includes the provinces located around the major city of Santa Cruz. They are Ibañez, Ichilo, Sara, Santiesteban, Warnes (Santa Cruz), and the southern half of Arce (Tarija). The number of square kilometers is estimated to be 30,825 (3,082,800 hectares) and the population is 192,740 according to 1972 estimates which is 4.2 percent of the total. The climate is also subtropical but the seasons are not as extreme as those of zone 3. The amount of rainfall and soil types seem to be well-suited for many varieties of crops. There are thick woods and heavy undergrowth throughout the zone. The entire region has a well-established system of secondary roads. Communication and transportation are even more facilitated by the main paved highway connecting Santa Cruz with the central valleys and highlands [See Fig. 3.2]. The major airline of Bolivia (Lloyd Aéreo Boliviano) along with lesser airlines have various daily flights to this area. Zone 4 has (one of) the best developed infrastructures in the whole country.

Zone 5 is called the Chaco. It is located in southeastern Bolivia and includes the Provinces of L. Calvo, H. Siles (Chuquisaca), G. Chaco (Tarija), Cordillera, and Florida (Santa Cruz). The area is 126,577 square kilometers (12,657,700 hectares). The estimated population is 177,188 people which is 3.9 percent of the total. This zone is largely composed of a vast plain. The climate is dry with frequent winds from the south (surasos) that play havoc with the temperature. The mean annual temperature is 23°C (73°F) but extremes of 0°C (32°F) to 44°C (111°F) are not uncommon. The rainfall also varies. In the west, around 1100 mm. (43 inches) is the average while farther east it is only 500 mm. (20 inches) [11]. Roads exist throughout the zone but only one main road is maintained for all-weather travel. A main railway crosses the zone from north to south connecting Santa Cruz and Yacuiba [See Fig. 3.2].

Zone 6 is named Valles. This is an attempt to include valleys of about the same altitude and climate into one zone. There are many provinces of various departments that make up the zone which extends from the capital of La Paz through central Bolivia to Tarija. It includes the Provinces of Arce, Avilez, Mendez, O'Connor, Cerado (Tarija), N. Chichas, S. Chichas, Omiste, Bilbao (Potosí), Campero, Mizque, Arque, E. Arce, Tapacari, Quillacollo, Arani, Ayopaya, Capinota, Punata, Jordan (Cochabamba), Saavedra, Muneca, Larecaja, Murillo, Loayza (La Paz), Vallegrande, Caballero (Santa Cruz), S. Cinti, N. Cinti, Boeto, Azurduy, Tomina, Zudanez, Oropeza, and Yamparaez (Chuquisaca). The surface is 133,821 square kilometers (13,182,100 hectares) and the number of inhabitants is 2,071,744 which is 45.4 percent of the total. The entire zone is composed of different mountain ranges of the Andes Mountains with many valleys between. The climate is mild with small variations throughout the year and the temperature averages 18°C (64°F). Rainfall is anywhere from 400 mm. (16 inches) to 1000 mm. (39 inches) [11]. The terrain is well-suited for many types of crops. There are many secondary roads in which movement is possible only during certain seasons due to the roughness of the mountains and the violent rains of the rainy season. A major road is maintained from La Paz to Cochabamba and Oruro and, weather permitting, to the cities of Sucre, Potosí, and Tarija [See Fig. 3.2]. Air service is available year around to the major cities.

Zone 7 is called the Yungas. The provinces comprising this zone are Inquisivi, S. Yungas, N. Yungas, Caupolican (La Paz), Chapare, and Carrasco (Cochabamba). The area is 60,710 square kilometers (6,071,000 hectares) and the population is estimated to be 263,353 people which is 5.8 percent of the total. The climate is hot and very humid which accounts for the dense vegetation. Most of the Yungas could be termed as a tropical jungle with various rain forests. Roads are difficult to build and maintain in most areas but some secondary ones do exist and are passable most of the year. Recently an asphalt road was completed from the city of Cochabamba into the Chapare region [See Fig. 3.2]. Tropical crops are well-adapted to this zone.

Zone 8 is the Altiplano Norte. This is the smallest zone in area. It surrounds the shores of Lake Titicaca on the Bolivian side. The Provinces of Camacho, Los Andes, Omasuyos, and M. Kapac (La Paz) make up the area which is only 6,170 square kilometers (617,000 hectares). About 306,120 people live here which is 6.7 percent of the total. The altitude is from 8000 feet to 14,000 feet above sea level which explains the large fluctuations in temperature between day and night and consequently the cold climate. The average annual temperature is around 11°C (52°F). Rainfall is about 400 mm. (16 inches) a year but most of it comes in the period from November to March [11]. Little vegetation survives in these high altitudes so roads are readily built and easily maintained. In spite of this though, there are no asphalt roads in the zone. The main railway from La Paz to Guaqui passes through the zone [See Fig. 3.2].

Zone 9 is called <u>Altiplano Centro</u>. It includes the provinces of Ingavi, Aroma, Villaroel, Pacajes (La Paz), Cercado, Carangas, Sajama, Litoral, Dalence, Aboroa, Saucari, Poopo, Atahuallpa (Oruro), Chayanta, Charcas, Ibañez, Saavedra, Bustillo, Linares, and Frias (Potosí). The calculated area is 94,511 square kilometers (9,451,100 hectares) and the population is 1,144,296 which is 25.1 percent of the total. The climate is similar to zone 8 except it seems that the growing season is slightly milder allowing cultivation of a few more crops. The temperature would average about 11°C but because the zone is a high plain surrounded by mountain ranges, only infrequent variations of the magnitude of zone 8 occur. Many secondary roads connect villages with the main road which joins La Paz, Oruro, and Potosí. This latter road is paved to Oruro. Two main railway lines cross the zone. The first extends to Arica, Chile. The second also reaches a Chilean city, Antofagasta, but it runs the whole length of the area passing through the city of Oruro and branching off to Potosí. Both railroads provide important links with seaport cities [See Fig. 3.2].

Zone 10 is named <u>Altiplano Sud</u>. It is made up of the provinces of Cabrera (Oruro), Quijarro, Campos, N. Lipez, and S. Lipez (Potosí). The area is estimated at 81,315 square kilometers (8,131,500 hectares) and the population is 95,140 people which is 2.1 percent of the total. Zone 10 is an extension of the high plain of Bolivia and extends south to the border of Chile and Argentina. The distinguishing feature is a vast salt flat which occupies one fourth of the whole zone. The climate is drier with about the same range of temperatures. The soil types are less productive because of higher salt content. Some secondary roads do exist throughout the region. The main link with other areas though, is the railway which comes from Oruro and branches in the zone at Uyuni. One branch goes to Chile and the other to Argentina [See Fig. 3.2].

Area and population distribution by zone are summarized in Table 3.1.

Data Collection

The coefficients for the program matrix were obtained from cost of production budgets contained in a recent study published in 1972 [11]. The budgets illustrate production costs of various crops raised in Bolivia. Different political departments had their own separate budgets. Establishing representative budgets for the different zones (the departments and zones are different regions) was no problem. For any designated zone and crop, budgets were taken from every department that overlapped into that zone. Weighted averages, based on percentage of total crop produced by each department, were used to combine the different budgets into a budget that represented the cost of production for that crop in that zone. Each crop production budget is based on the amount of resources necessary to enable production of that crop over an area of one hectare of land. Only variable costs were included in calculating the cost coefficients.

Yields pertaining to the different technologies were also obtained from the study. Cross-checking these data with a recent rural production/

TABLE 3.1. Estimated Area and Population of Production Zones 1972 and 1985

Zone	Area (km^2)	Rank	Population (1972)	Rank	Inhabitants (km^2) (1972)	Population (1985)	Rank	Inhabitants (km^2) (1985)
Amazonica	184,358	2	115,722	7	.63	187,245	7	1.02
Pampas de Moxos	135,848	3	100,762	8	.74	163,562	8	1.20
Chiquitana	240,683	1	81,784	10	.38	148,760	10	.62
Santa Cruz Centro	30,828	9	192,741	5	6.25	312,322	5	10.13
Chaco	126,577	4	177,188	6	1.40	287,159	6	2.27
Valles	33,821	8	2,071,744	1	61.26	3,363,014	1	99.44
Yungas	60,710	7	263,353	4	4.33	427,038	4	7.03
Altiplano Norte	6,170	10	306,122	3	49.61	496,607	3	80.48
Altiplano Centro	94,511	5	1,144,296	2	12.11	1,857,651	2	19.66
Altiplano Sud	81,315	6	85,147	9	1.17	153,941	9	1.89
TOTAL	1,094,831		4,558,859			7,401,000		

Source: [10].

consumption study completed by the Ministry of Agriculture in conjunction with USAID, suggested that some adjustments be made. Since yield values are very sensitive to the function of the program, these changes were undertaken with much care.

Data Arrangement

The study includes twenty-two crops. Representative cost of production budgets were established for the crops raised in the different zones. They include budgets of present technologies as well as estimated budgets for more intensive methods of production. Irrigation development and addition of fertilizer were the two most used variations of the traditional technology. Table 3.2 shows the distribution of the crops by zone, the different technologies used, and their yields in each zone.

Columns

There are 308 columns in the program. Column activities are classified into one of the following groups: crop technology, labor transfer, water development, fertilizer purchases, capital acquisition, and land development. Four crop technologies are included in the study: traditional, a state of labor-intensive production where only hand tools are used; traditional irrigated, labor-intensive application of water to traditional techniques; traditional fertilized, labor-intensive application fertilizer to traditional techniques; and modern, application of water and fertilizer by modern methods to capital-intensive production processes. Presently, most crops are not irrigated or fertilized except in special cases such as potatoes where natural fertilizer and hand-diverted water are applied.

TABLE 3.2. Distribution of Crops, Technologies, and Yields by Zone

Crop	Technology	Zones 1	2	3	4	5	6	7	8	9	10	Yield by Zone (Ton/ha) 1	2	3	4	5	6	7	8	9	10
Rice	Traditional	X	X	X	X	X		X				1.51	1.51	1.37	1.7	1.35		1.5			
	Irrigation	X	X	X	X	X						1.73	2.0	1.41	1.85	1.5					
	Fertilizer							X										1.7			
	Irrigation & Fertilizer	X	X	X	X	X						1.83	2.1	1.51	1.95	1.61					
Corn	Traditional	X	X	X	X	X	X	X		X		1.82	1.67	1.26	1.34	1.19	1.3	1.4		.77	
Corn Silage	Traditional						X	X		X							3.2	12		3.0	
Sugar Cane	Traditional	X	X	X	X	X						20	32	31	35	34					
	Irrigation	X	X	X	X	X						40	52	51	85	84					
	Irrigation & Fertilizer	X	X	X	X	X						60	72	71	95	94					
Banana	Traditional	X	X	X	X	X		X				.97	3.8	.68	4.7	1.2		.67			
Pineapple	Traditional	X	X		X			X				3.0	3.2		3.5			3.5			
	Fertilizer	X	X		X			X				3.5	3.8		4.4			4.0			
Beef	Traditional	X	X	X	X	X	X	X	X	X	X	.2*	.2*	.15*	.15*	.17*	.10*	.20*	.10*	.10*	.10*
Coffee	Traditional	X	X		X			X				.56	.69		.13			.77			
	Fertilizer	X	X		X			X				.70	.83		.27			.87			
Sweet Potato	Traditional	X	X	X	X	X	X	X				14	13.5	14	14	13.5	13.5	13			
Tobacco	Traditional	X	X		X			X				.33	.24		.44			3.0			
Cotton	Modern			X	X	X								.37	.37	.32					
	Fertilizer			X	X	X								.48	.50	.36					
Soybeans	Modern			X	X									.55	.62						
Potatoes	Traditional Irrigation & Fertilizer				X	X	X	X	X	X	X				8	11	12	9.8	4.8	4.8	5
	Intensive Traditional Irrigation & Fertilizer				X	X	X	X	X	X	X				9	13	14	11	8	7.6	7
Oranges	Traditional				X	X		X							7.5	66		80			
	Fertilizer				X	X		X							8.5	70		95			
Milk Cows	Traditional				X		X								3		3				
Peanuts	Traditional				X		X								1.4		.55				
	Intensive Traditional				X		X								1.5		.63				
Barley	Traditional						X		X	X							.61		.81	.45	
Barley Silage	Traditional						X		X	X							2.18		1.3	1.9	
Wheat	Traditional						X	X		X							.6	.64		.46	
	Irrigation						X			X							.77			.65	
	Fertilizer						X	X		X							1.82	2.73		.58	
	Irrigation & Fertilizer						X			X							2.64			.78	
Quinoa	Traditional						X		X	X	X						.78		.81	.2	.44
Coca Leaf	Traditional Variety A							X										.85			
	Traditional Variety B							X										.26			
Sheep	Traditional								X	X	X								.5*	.5*	.5*

*Number of head per hectare.

Labor transfer activities are included in all zones. Their purpose is to allocate surplus labor to deficit labor areas. The transfer costs are based on distance and availability of labor for each zone [See Appendix A].

Water development, fertilizer purchases, and capital acquisition are activities which expand the original RHS constraints. Each of the respective activities allow additional amounts (water, fertilizer, or capital) to be purchased as required. The total for each activity appears in every zone. They represent the requirements for that zone of water, fertilizer, and capital that comply with the solution indicated by the objective function.

Land development activities are included in order to estimate total land use in the year 1985. Since the objective is to estimate the area of land in production by 1985 subject to specific crop production targets, presumably, the amount of land in use will increase. Budgets for the cost of clearing and developing land under different practices were obtained [12]. Two techniques for developing land have been selected and applied to the appropriate land types. One is a labor-intensive method while, the other is machinery-intensive. All zones are equipped with land development activities in the program.

Rows

There are 196 rows in the matrix. They consist of major divisions for land, labor, and capital. Two subdivisions of water and fertilizer are separated from general capital in order that effects of new technology can be more readily observed.

The study includes seven types of land. The classifications were very broad and based on land use rather than soil types. For example, crops grown in $land_1$ reach their highest yields in this land type. They do poorly on $land_2$ and therefore, are not as competitive with $land_2$ crops as with $land_1$ crops. Land 1 is the type of land occupied by corn, corn silage, sweet potatoes, barley, barley hay, potatoes, wheat, and quinoa. Land 2 consisted of only rice production. Land 3 constituted the lower altitude crops of sugar cane, cotton, soybeans, and peanuts, while land 4 was made up of the more tropical crops of bananas, pineapples, coffee, oranges, tobacco, and coca leaf. Land 5 was reserved for beef cattle, land 6 for milk cows, and land 7 for sheep raising.

The labor row is based on wages rather than man-days, hours, or other types of physical measurements. This method is employed because of the nonconformity of many budgets. Certain assumptions concerning the wage rate per day for the different zones allows easy manipulation of the monetary figure into man-days or hours. Matrix cells that have positive values are interpreted as the amount of labor in pesos required to cultivate one hectare of any specified crop.

The capital row is based on the amount of investment in tools and machinery necessary to produce one hectare's worth of any particular crop. Examples of some of the items allowed for in this row are pesticides, machine labor, transportation costs, storage costs, rent for custom harvesting, rent for a team of oxen, feed, animals, shovels, picks, and seed.

Capital is aggregated into a single row because of structural difficulties of the model and the nonconformity of different capital classifications. For example, when unaggregated, the LP model would select a technology that included pesticides as an input. The model would reach the point where the total amount available is utilized and still more could be used if it were available. Upon reaching this point, the program would either select another technology or conclude with an infeasible solution. Expansion activities could have been established for each separate capital item but this would have more than tripled the size of the matrix. Due to the fact that only a few of the capital inputs are of interest in this study, aggregation was the chosen alternative. Aggregation is the only procedure where the data could be saved while allowing the model enough freedom to reach an optimal solution.

Irrigation is omitted from the above aggregation so it can be analyzed separately. This row is understood as the amount of pesos needed to develop irrigational facilities that would provide water for one hectare. In most zones, the irrigation coefficients are one of three values due to the consideration of only the construction and maintenance of the structures bringing the water to the field and not of its application. This is a valid assumption for two reasons. First, there is no charge for the volume of water used. If charges for water do exist, they are fixed yearly fees irrespective of amount used. Second, the additional labor required for application procedures is included in the labor row.

Using fertilizer is a rather new production process in Bolivia so it is important to form a separate row facilitating its study. This row is set forth as the amount in pesos of fertilizer applied to one hectare of land. The amount of capital required for application of fertilizer varies considerably depending whether natural or commercial types are used.

The remaining rows are composed of elements making up an interzonal labor transfer matrix.

Constraints

Constraints are constructed for each row to satisfy the conditions of the right hand side. In calculating constraints for land, totals obtained from the recently completed study of rural production and consumption by USAID provides base figures for most types of land. For example, in deriving the constraint for $land_{11}$ (land type 1 in zone 1), the number of crops classified in this land type is first taken into account; next, their respective occupied hectares are figured; and finally, the summation of individually occupied hectares for crops in this land type constitute the base constraint. These base constraints correspond to the year 1972. Constraints for land types 1, 2, 3, and 4 are all set in this manner.

Constraints for land types 5, 6, and 7 are calculated by a different method because of data problems. These three classes of land are assigned to different types of livestock. Estimations of actual numbers of each type of animal are established for each of the different zones. Figures on the average head raised per hectare multiplied by the number of animals results in a reliable estimate of occupied land in 1972 [11].

Labor constraints are computed based on the assumption that the population distribution will be the same in 1985 as it is in 1972. Starting with the projected population figure for 1985 of 7,401,000 people [Table 3.1], the projected population of each zone for 1985 is calculated using the present percentage of total population for each zone. Next, through the assumption that 60 percent of the people are rural and 40 percent are urban, the amount of rural population for each zone is secured. Assuming 35 percent of rural people to be active gives the total available rural labor force per zone [5, p.5]. It is necessary to convert this amount into monetary units. To do this, daily wages are estimated for each zone then the total amount of labor available for hire multiplied by daily wages multiplied by 280 days results in the peso value of total available yearly labor per zone. The results for each zone are summarized in Table 3.3. The amount of available labor for each zone by the year 1985 is difficult to fix due to its mobility. Therefore, a labor matrix was built into the program to allow zones with surplus labor to be able to transfer manpower to zones with deficit labor [See Appendix A].

The aggregate capital constraints are less significant to the study, consequently, personal estimates are used. The amount of capital in pesos required to produce one hectare of output by the traditional method is multiplied by the land constraint for that land type and these figures are summed to arrive at a tentative capital constraint for each zone. The water constraint is derived in the same manner but instead of using the traditional method, the technology with labor-intensive water development is used. Fertilizer is fixed at an arbitrary constraint of $b.1,200,000 available to each zone, based on fertilizer imports for 1970 [Appendix B, Table B.6].

The above procedures are justified because there must be enough capital available to match the present needs of capital activities in

TABLE 3.3. Total Available Labor by Zone

Zone	Present Population Distribution %	Total Population 2 x 3	Number of Rural 60% x 3	Number Available For Hire 35% x 4	Daily Wages in $b[a]	Value in $b of Labor/Day[a] 5 x 6	Value in $b of Labor/Year[a] 280 days x 7
1	2.53	187,245	112,347	39,322	12	471,858	132,120,240
2	2.21	163,562	98,137	34,348	13	446,525	125,027,084
3	2.01	148,760	89,256	31,240	13	406,115	113,712,144
4	4.22	312,322	187,393	65,588	15	983,815	275,468,340
5	3.88	287,159	172,295	60,303	14	844,248	236,389,328
6	45.44	3,363,014	2,017,807	706,232	13	9,181,020	2,570,685,572
7	5.77	427,038	256,223	89,678	12	1,076,135	301,317,744
8	6.71	496,607	297,964	104,288	12	1,251,450	350,406,000
9	25.1	1,857,651	1,114,591	390,107	12	4,681,280	1,315,439,792
10	2.08	153,941	92,365	32,328	12	387,931	108,620,736
TOTAL	100	7,401,000[b]	4,440,600[b]	1,553,434		19,730,377	5,529,186,980

[a]Calculated at exchange rate of 12 pesos equal 1 dollar.

[b]Difference due to rounding errors.

Source: Table 3.1 and Appendix A.

the model. Upon reaching these current needs, capital column activities allow increments to enter the program. Capital and water are priced at a 15 percent interest rate while fertilizer has a fixed purchase price which results in total amount in pesos of fertilizer required for a given zone in keeping within the optimal solution. The capital constraints are established mainly to satisfy the sufficient conditions of the LP model.

Production Targets

The remaining rows are constructed to represent production targets for each of the twenty-two crops in the year 1985. The program objective is to minimize costs in reaching all targets. The presence of market fluctuations through time make it difficult to assess the proper resource allocation that would justify the targets. Crude projections of consumption and production exist for some of the crops and in this respect partial escape from the assumption of linear trends is possible. In some cases though, the projections are unreasonable mainly due to assumed elasticities, so reliance on proportions and linear projections are necessary. Table 3.4 shows the selected targets and the variations around them.

The target for rice is set at 91,233 metric tons (mt). This figure is based on apparent domestic consumption in 1985 of 74,100 mt and the present (1972) estimated surplus.

Consumption is related to population and calculated from 1985 population projections. Rice surpluses are not directly related to population growth because (a) Bolivian rice is of a low quality which makes it difficult to export, and (b) random climatic conditions that

TABLE 3.4. Target Values Used in Program

Crop	Original	15% Reduction	15% Increase	
	(Metric Tons)	(Metric Tons)	(Metric Tons)	
Rice	91,233	77,548	104,918	
Corn	542,400	461,040	623,760	
Corn Silage	10,000	8,500	11,500	
Sugar Cane	2,971,191	2,525,512	3,209,870	
Banana	317,542	269,911	365,173	
Pineapple	1,000	850	1,150	
Beef	5,244,366	4,457,711	6,031,021	
Coffee	15,000	12,750	17,250	
Sweet Potatoes	336,055	285,647	386,463	
Tabacco	500	425	575	
Cotton	50,000	42,500	70,000[a]	40% increase
Soybeans	14,000	11,900	16,100	
Potatoes	999,135	849,265	1,149,005	
Oranges	72,676	61,775	83,577	
Milk Cows	257,628	218,984	296,272	
Peanuts	6,000	5,100	6,900	
Barley Hay	242,013	205,711	278,315	
Barley	95,473	81,152	109,794	
Wheat	378,348	321,596	435,100	
Quinoa	72,000	61,200	82,800	
Coca Leaf	5,498	4,673	6,323	
Sheep	3,184,650	2,706,953	3,662,348	

[a]Cotton was increased 40 percent due to recent market developments.

affect yields are unpredictable. Taking into account these factors, estimates of the 1985 surplus is about 17,133 mt. [12]. The target is set by adding the estimates for consumption and surplus.

Corn is used mainly for domestic purposes. Projections for 1985 estimate that 542,400 mt. will be produced [12]. Consumption is figured to be about 438,382 mt. with the surplus going to animal and other nonhuman consumption [19].

Data projections for corn silage are unavailable. Present production is figured to be about 7,237 mt. [21]. Based on population projections, the amount of 10,000 mt. is set as the target.

The sugar cane production target is set at 2,971,191 mt. Per capita for 1972 sugar consumption is calculated to be 28 kilograms. By 1985, per capita consumption is expected to increase to 35.8 kilograms. Multiplying the latter figure by 7,401,000 (projected 1985 population), total sugar consumption is estimated to be 249,232 mt. Sugar cane yields about 9.4 percent sugar, so consumption is divided by 9.4 percent to obtain the consumption in sugar cane of 2,651,401 mt. The target is set higher than domestic consumption because Bolivia exports sugar to other countries. Allowing for gradual increases in exports, 1985 projections set production at 2,971,191 mt. [11].

Future estimates of banana production varied greatly. Difficulties arose when trying to calculate consumption due to lack of data. Production figures for 1972 of 230,000 mt. are allowed annual increases based on population increases. The 1985 production target of 317,542 mt. is based on (a) consumption of 42.905 kilograms per capita, and (b) the 1985 projected population of 7,401,000 people [11].

Pineapple is a new crop to Bolivia. Insignificant quantities were grown wild until recently, when small pieces of land have been used for cultivation of this crop. No national figures exist for pineapple but one study estimated present production to be 458 mt. [20]. Expecting an increase in pineapple production, the target is set at 1,000 mt.

Lack of sufficient quantities of meat in an average Bolivian's diet has resulted in establishing desired levels of future beef production. The target is set based on estimates that 120,543 mt. of slaughtered beef (carne vacuna) will be produced by 1985. Taking into account the number of head needed for slaughter, number of head needed to increase herd size, and the number of head needed for domestic use, the total number of head needed in 1985 to satisfy the estimate for slaughtered beef is calculated to be 5,244,366 [11]. Thus, the target is set at this number.

Coffee has international controls which affect its production. Present (1972) production is estimated at 13,000 mt. Bolivia, in meeting its international quota, can export 8,872 mt. which is 147,874 sacks of 60 kilograms each. Consumption is figured to be about .82 kilograms per capita which results in 6,128 mt. [11]. The target for 1985 is 15,000 mt. which is the summation of exportation and projected consumption.

Sweet potatoes are mainly grown in garden plots by most rural families. The national estimate of production for 1972 was 242,000 mt. [19]. Increased production is based on population growth and projected to be 336,055 mt. by 1985 [18]. The target is set at this figure.

Tobacco has only reached significant production levels since 1970 [19]. Consumption and production data are unavailable though 1972 estimates range from 235 mt. [20] to 1,300 mt. [19]. The target is set at 500 mt. based mainly on a recently completed inquiry of rural consumption and production [20].

Changed world market conditions now favor the production of cotton. Production has rapidly increased the past few years making future projections very difficult. Based on current studies that estimate 1972 production to be 15,500 mt. [19] and 18,074 mt. [20], respectively, the target is set at 50,000 mt. for 1985. This allows for 135,000 hectares to be used for cotton production at a yield of .37 mt. per hectare. Cotton production occupied about 46,000 hectares in 1972. The target allows for a 200 percent increase.

Soybean is another crop that is in the infant stage in Bolivia. Current sources estimate that 1,200 mt. to 2,000 mt. were produced in 1972 [19, 20]. One source projects 1985 production to be 49,980 mt. [11]. Observation reveals that production methods are shifting to soybeans at a slower rate than expected. Due to this, the target is set at a conservative 14,000 mt.

One of the main staples for over 75 percent of the population is potatoes. It is estimated that Bolivians consume .135 mt. of potatoes per capita each year [11]. Based on population increases (7,401,000) and consumption per capita, the 1985 target is set at 999,135 mt. Mention should be made that consumption is figured to be only 799,308 mt. (80 percent). The surplus will be preserved in storage for future consumption by an ancient method of freeze-drying.

Domestic consumption of oranges amounts to almost the entire amount produced. National statistics for 1972 estimate production to be 60,000 mt. [19]. Consumption is calculated to be 9.71 kilograms per capita [11]. Based on 1985 population projections and allowance of slightly over 1 percent for exports, the resulting target is 72,676 mt.

The heading "milk cows" is intended to also include derived dairy products. In 1972, Bolivia was estimated to have 34,719 head of milk cows which produced 3,642,000 liters of milk [11]. Projections to 1985 show an increase to 257,628 head producing 396,432,000 liters of milk [11]. The target of 257,628 head is based on these estimates.

The target for 1985 peanut production is a conservative 6,000 mt., due to conflicting data. Estimates from 1972 ranged from 1,050 mt. to 6,900 mt. [11, 19]. More confidence is placed in the lower quantity due to the fact that presently cotton and sugar cane production are more profitable crops which compete for the same type of land. Also, the absence of peanut oil processing facilities discourages rapid increases in production.

The targets for barley and barley hay are derived with exactly the same procedure. Present production is related to 1972 population. The results show that .0327 mt. of barley hay per capita and .0129 mt. of barley grain per capita are produced [20]. Multiplying the 1985 projected population by these two factors gives the targets of 242,013 mt. and 95,473 mt. for barley hay and barley grain, respectively. It is assumed the population has correlation with production and consumption by both livestock and people.

The wheat target is 378,348 mt. This is based on the projected amounts of traditional and nontraditional land to be in use by 1985 [11]. The results are obtained when the number of hectares is multiplied by respective yields. They are: traditional 184,987 ha. x .6 mt. = 110,992 mt.; traditional irrigated 142,020 ha. x .77 mt. = 109,356 mt.; and modern irrigated 60,000 ha. x 2.64 mt. = 158,000 mt. [11, Table 3.2]. Consumption is estimated to be 386,164 mt. resulting in importation of about 10,000 mt. in 1985 [18].

Projected quinoa production is based on 1972 production of 50,000 mt. [20]. The target is set at 72,000 mt. due to projected 1985 population. Consumption per capita is estimated to be 9.72 kilograms per person.

The coca leaf production target of 5,498 mt. is based on consumption per capita and production of two varieties. The "Chapare" variety is grown in the eastern part of zone 7 (See Fig. 3.1). 1985 projections estimate that 3,560 mt. will be produced resulting in a per capita consumption of .481 kilograms [15]. The "Yungas" variety is raised in the western region of zone 7. Maintaining per capita consumption at .261 kilograms, 1,938 mt. will be produced in 1985 [15].

The number of sheep in 1972 was estimated to be 2,239,814 head. Based on 1985 population and consumption projections, the sheep production target is set at 3,184,650 head [11].

Differences between production projections and actual production realized in future time periods are due to the effects of stochastic variables and unforeseen events. In trying to compensate for these effects, a range is established for each production target. The lower parameter is 15 percent below the values of the original targets. The upper parameter is 15 percent above the original target values, except the cotton production target whose production increased 40 percent. Exception is made for cotton because of unstable production patterns and because of favorable changes in world market conditions. Table 3.4 shows the original targets and the parametric values used in the program.

CHAPTER IV

RESULTS

Initial Run

The model is allowed to reach an optimal solution without the imposition of artificial restrictions. The objective function showed a total cost of $b.3,532,002,834. The allocation of the crop inputs is shown in Table 4.1 and the distribution of the various technologies among the zones is summarized in Table 4.2.

The largest amount of labor is required in zone 5. The major portion of beef production is assigned to this zone. Further production is constrained by labor because this input has reached its limit in zone 5. Instead of increasing the wage to attract more labor, the least-cost solution assigns beef production to another zone. Zones 4 and 6 are the next highest demanders of labor.

Water development is mainly assigned to zones 9, 6, and 1. Zone 9 requires an investment of $b.7.0 million to develop irrigation for production of wheat. Though zone 6 has higher yields, the program allocates more water investment to zone 9. Irrigation in zone 1 would be used for rice production.

Zone 6 demands the most fertilizer. It is applied to wheat and potatoes. Demand in zones 3, 4, 5, and 7 closely follows that of zone 6. Zones 3 and 4 apply fertilizer to cotton, zone 5 uses it in sugar cane production, and zone 7 increases yield of rice and wheat by inputting fertilizer.

TABLE 4.1. Initial Run Allocation of Inputs

Input / Zone	Labor[a] $b*	Irrigation $b*	Fertilizer $b*	Capital $b*	Land 1 Ha.	Land 2 Ha.	Land 3 Ha.	Land 4 Ha.	Land 5 Ha.	Land 6 Ha.	Land 7 Ha.
1	156,086,000	1,931,005	---	83,395,000	145,850	42,911	---	---	4,000,000	---	---
2	93,450,900	---	---	178,873,800	9,194		85,571	4,711	2,000,000		
3	18,417,700	---	87,600	20,206,210	16,840	---	1,095	---	---	---	---
4	275,435,000	---	1,267,159	541,742,500	12,077	---	121,529	63,753	---	85,876	
5	303,929,000	128,856	1,189,440	35,402,300	29,767	---	2,478	---	19,576,500		---
6	228,523,000	5,645,592	1,661,284	231,527,000	413,678	---	10,909	---	---	---	---
7	60,578,600	---	1,410,181	66,575,400	50,380	9,998		27,310	3,581,788		---
8	27,390,300	---	---	24,533,400	73,971				---		220,000
9	128,203,000	6,942,915	---	103,080,000	324,474						5,929,300
10	776,600	---	---	303,600	---	---					220,000
TOTAL	1,292,790,100	14,648,368	5,615,664	1,285,639,210	1,076,231	52,909	221,582	95,774	29,158,288	85,876	6,369,300

*12 pesos = 1 dollar.

[a]Labor can be converted to the size of the needed labor force by dividing the peso value by 280 days then dividing that sum by the daily wages for that zone (see Table 3.3). For example, the man/days required in zone 4 are divided by: $b.275,435,000 ÷ 280 days = $b.983,696/day; $b.983,696/day ÷ $b.15/day = 65,580 laborers.

Table 4.2. Initial Run Distribution of Production Target Achieving Solutions by Technology and Zone

Crop	Target	Land Type	Zone	Technology[a]	Metric Tons	% of Target
Rice	91,233	2	1	1	74,236	81
			7	2	16,997	19
Corn	542,400	1	1	0	265,449	49
			2	0	15,354	3
			3	0	4,532	1
			4	0	16,183	3
			5	0	35,423	6
			6	0	206,760	38
Corn Silage	10,000	1	7	0	10,000	100
Sugar Cane	2,971,191	3	2	0	2,738,272	92
			5	3	232,932	8
Bananas	317,542	4	2	0	17,902	6
			4	0	299,639	94
Pineapple	1,000	4	7	0	1,000	1,000
Beef	5,244,366*	5	1	0	800,000	15
			2	0	400,000	8
			5	0	3,328,005	63
			7	0	716,358	14
Coffee	15,000	4	7	0	15,000	100
Sweet Potatoes	336,055	1	1	0	336,055	100
Tobacco	500	4	7	0	500	100
Cotton	50,000	3	3	2	526	1
			4	2	49,474	99
Soybeans	14,000	3	4	0	14,000	100
Milk Cows	257,628*	6	4	0	257,628	100
Barley	95,473	1	6	0	16,291	17
			8	0	59,917	63
			9	0	19,265	20
Barley Hay	242,013	1	9	0	242,013	100
Wheat	378,348	1	6	3	142,798	37
			7	2	135,261	36
			9	1	100,287	27
Quinoa	72,000	1	6	0	72,000	100
Peanuts	6,000	3	6	0	6,000	100
Oranges	72,676	4	7	0	72,676	100
Coca Leaf	5,498	4	7	0	5,498	100
Sheep	3,184,650*	7	8	0	110,000	3
			9	0	2,964,650	93
			10	0	110,000	3
Potatoes	999,135	1	6	3	999,135	100

*Number of head.

[a]0 = traditional, 1 = traditional irrigation, 2 = fertilizer, and 3 = irrigation and fertilizer.

Zone 4 demands more than twice as much capital as any other zone. Much capital is substituted for labor in producing cotton, soybeans, and milk cows. In addition, land is developed by a capital-intensive process. Most new land goes to cotton and milk cow production. The capital to labor ratio is about 2 to 1. Zones 2 and 6 are the highest demanders of capital. Their capital to labor ratios are 1.9 and 1.0, respectively.

Many zones are large users of different land types due to production requirements of one or two crops. Zone 6 is the largest demander of $land_1$. Large potato and wheat production in this zone make up most of $land_1$ usage. Zone 1 requires large amounts of $land_2$ to produce rice. The largest user of $land_3$ is zone 4 to raise cotton and soybeans. Zone 4 also requires the highest amount of $land_4$ to grow bananas. $Land_5$ is demanded mostly by zone 5 for beef production. The sole user of $land_6$ is zone 4 to develop milk cow production. Sheep raising is the reason why zone 9 is the highest demander of $land_7$.

Base Run

The present distribution of agricultural production was ignored in the initial least-cost computer run. The results showed some allocations that would be impossible because of physical limitations in many zones. For instance, the model assigned 81 percent of all rice to be produced under irrigation in zone 1 with a required investment of $b.1.9 million in traditional irrigation methods. This may well be the most productive area as far as yield is concerned, but presently there exists poor infrastructure and market connections. Qualifications such as this, justify the placement of limits (bounds) that superficially confine the cultivation of certain crops to specific practices and zones. Consequently, bounds are placed on crop production in most of the zones. They represent a certain percentage of traditional production based somewhat on present distribution [Appendix III].

The objective function increases to a value of $b.4,020,000,787 with bounds placed on different zones. The objective functions of the base and initial programs differ by about $b.488,000,000. This could be interpreted as the cost of the immobility of resources resulting from failure to take advantage of superior technologies in more productive zones. The present value of $b.488 million discounted at 15 percent suggests that, theoretically, only an investment of $b.105 million would be required at the beginning of 1974 to reduce costs to $b.3,532,000,000 by 1985. The optimum allocation of investment funds among the inputs in the different zones requires that large numbers of people and even whole cities would have to relocate. It also requires that certain physical limitations be overcome where, in some cases, they are insurmountable. For example, much of the land in zone 7 is uninhabitable by man or crops because it is located on steep mountainsides or inundated by rivers and bogs. In addition, the people themselves may perish due to the fact that diseases, such as tuberculosis which is dormant in the higher altitudes of zones 6, 8, 9, and 10, may become active in tropical zone 7. For these reasons, this study will base its conclusions on the base computer program and its pertinent variations.

The results of the base run are shown in Tables 4.3 and 4.4.

TABLE 4.3. Base Run Allocation of Inputs

Input Zone	Labor $b*	Irrigation $b*	Fertilizer $b*	Capital $b*	Land 1 Ha.	Land 2 Ha.	Land 3 Ha.	Land 4 Ha.	Land 5 Ha.	Land 6 Ha.	Land 7 Ha.
1	169,869,000	789,776	---	80,679,400	165,802	22,244	730	408	4,000,000	---	---
2	64,305,000	---	---	104,484,900	9,194	4,140	47,883	4,711	2,000,000	---	---
3	23,516,800	---	12,400	24,599,360	16,840	3,420	1,095	---	---	---	---
4	264,965,000	10,800	1,258,654	642,306,500	12,077	14,432	164,295	62,212	---	10,000	---
5	303,929,000	10,350	---	45,696,200	2,209	380	7,100	66	20,261,000	---	---
6	196,375,000	3,524,621	1,480,115	361,608,000	413,678	---	2,181	---	---	75,876	---
7	103,676,000	---	1,578,933	113,577,900	95,490	9,998	---	51,966	3,000,000	---	---
8	23,963,100	---	940,000	24,533,400	63,204						220,000
9	72,228,000	10,093,530	---	117,227,000	324,474						1,400,000
10	73,400,700	105,525	938,000	8,819,304	2,345						4,749,300
TOTAL	1,296,227,600	14,534,602	6,208,102	1,523,531,964	1,105,313	54,614	223,284	119,363	29,261,000	85,876	6,369,300

*12 pesos = 1 dollar.

TABLE 4.4. Base Run Distribution of Production Target Achieving Solutions by Technology and Zone

Crop	Target (Tons)	Land Type	Zone	Technology[a]	Metric Tons	% of Target
Rice	91,233	2	1	0	8,864	10
			1	1	30,363	33
			2	0	6,251	7
			3	0	4,685	5
			4	0	24,534	27
			5	0	7,305	8
			7	0	8,718	10
Corn	542,400	1	1	0	301,760	56
			2	0	15,354	3
			4	0	15,862	3
			6	0	209,424	38
Corn Silage	10,000	1	7	0	10,000	100
Sugar Cane	2,971,191	3	1	0	14,600	.5
			2	0	1,532,256	52
			3	0	29,140	1
			4	0	1,351,000	45
			5	0	44,200	1.5
Bananas	317,542	4	2	0	13,665	4
			4	0	289,807	91
			7	0	14,070	5
Pineapple	1,000	4	1	0	420	42
			2	0	90	9
			4	0	231	23
			7	0	259	26
Beef	5,244,366*	5	1	0	800,000	15
			2	0	400,000	7.5
			5	0	3,444,370	66
			7	0	600,000	11.5
Coffee	15,000	4	1	0	150	1
			2	0	750	5
			7	0	14,100	94
Sweet Potatoes	336,055	1	3	0	235,760	70
			5	0	26,717	8
			6	0	73,575	22
Tobacco	500	4	7	0	500	100
Cotton	50,000	3	3	2	74	.1
			4	0	5,047	10
			4	2	43,023	86
			5	0	1,856	3.9
Soybeans	14,000	3	4	0	14,000	100
Milk Cows	257,628*	6	4	0	30,000	12
			6	0	227,628	88
Barley	95,473	1	8	0	47,388	50
			9	0	48,085	50
Barley Hay	242,013	1	9	0	242,013	100
Wheat	378,348	1	6	0	45,900	12
			6	3	48,597	13
			7	2	255,954	68
			9	0	16,247	4
			9	1	11,650	3
Quinoa	72,000	1	6	0	72,000	100
Peanuts	6,000	3	4	0	4,801	80
			6	0	1,200	20
Oranges	72,676	4	4	0	3,638	5
			5	0	4,356	6
			7	0	64,720	89
Coca Leaf	5,498	4	7	0	3,574	65
			7	0A	1,924	35
Sheep	3,184,650*	7	8	0	110,000	3
			9	0	700,000	22
			10	0	2,374,650	75
Potatoes	999,135	1	4	3	1,920	.2
			5	3	2,580	.3
			6	3	417,312	42
			6	3A	351,974	35
			7	3	8,820	.9
			8	3	22,560	2.3
			9	3	177,600	17.8
			10	3A	16,415	1.5

*Number of head.

[a] 0 = traditional, 1 = traditional irrigation, 2 = fertilizer, 3 = irrigation and fertilizer.

The imposed production restrictions cause reallocation to occur among the inputs. Some of the changes are obvious when comparing Tables 4.3 and 4.4 to Tables 4.1 and 4.2.

Zone 5 requires the same amount of labor and is the highest demander of this input. Imposition of restrictions caused labor use to decline in all zones except 1, 7, and 10. Artificial assignment of production to these zones is responsible for the overall increase of labor. Zone 1 increased only about $b.14.0 million while zone 7 increased by $b.43.0 million and zone 10 by $b.73.0 million. The total net increase of $b.4.0 million is the cost of additional labor in order that the production targets can be accomplished when bounds are used in the program.

Total water development decreased by a small margin of about $b.114,000. The zonal distribution for the top three users remains the same. Zone 9 increases water development by $b.3.0 million mainly due to increased potato production. Zones 1, 5, and 6 show decreases due partly to the fact that zones 4 and 10 are assigned irrigation development. The slight decrease in total development results because traditional technologies, which require no water, play a larger role in achieving production targets than in the initial program.

The fertilizer distribution is partially altered with zones 7 and 6 changing demand positions. Zone 7 shows an increased demand due to the climatic advantages of fertilizer application to wheat in that zone. Assignment of potato production to zones 8 and 10 causes these zones to enter the solution while the remaining zones show decreases in fertilizer use. The total fertilizer demand increased about $b.600,000 due to production restrictions.

Demand for capital showed the largest increase of all inputs. The demand rose almost $b.240.0 million. Large increases are noted in zone 4, $b.100.0 million, zone 6, $b.130.0 million and zone 7 $b.47.0 million. Zones 3, 5, 9, and 10 all had increases of $b.4.0 million to $b.14.0 million. A slight decrease occurred in zone 1 while zone 2 had a significant reduction of $b.74.0 million mainly due to decreased sugar cane production in that zone. The leading capital users, zones 4, 6, and 9, had changes in their capital to labor ratios of 2.0 to 2.4, 1.0 to 1.8, and .8 to 1.6 in that order. Zone 2 had a decline from 1.9 to 1.6. It appears that when restrictions are imposed, major capital to labor substitution occurs in zones 4, 6, and 9.

Zones 6 and 9 remained the highest demanders of $land_1$. The only major change comes in zone 5. Due to exclusion of corn production, $land_1$ usage declines by 27,000 hectares.

Zone 1 decreases its use of $land_2$ when the program bounds assign zones 2, 3, 4, and 5 amounts of this land type. Zone 1 is still the highest demander with zone 4 replacing zone 7 as the second highest demander.

The most notable change in $land_3$ occurs in zone 2. Land use declines by almost 40,000 hectares in this zone due to reduction in sugar cane production. Zones 4 and 2 are the largest demanders.

$Land_4$ shows no change in the distribution of the top three users which are zones 4, 7, and 2. Zone 7 increased significantly but not enough to overtake zone 4. The increase in zone 7 is mostly attributed to increased production of bananas.

The smallest changes occur in $land_5$. Zones 5 and 1 are still the largest users. Zone 5 increased slightly while zone 7 decreased slightly.

Complete changes in distribution happens with $land_6$ and $land_7$. In $land_6$, milk cow production shifted almost entirely from zone 4 to zone 6. In $land_7$, zone 10 becomes the high demander with zone 9 decreasing demand while zone 8 remains unchanged.

The total quantity of usage for all land types increased except for $land_6$ and $land_7$ which remained at the same level.

Parametric Procedures

Parametric procedures are used in the program to analyze the changes in allocation of inputs as various alterations are made in target values. It would be useful to perform an extensive analysis to observe changes in input allocations as each target is varied. Unfortunately, due to costs involved, the alternative of increasing and decreasing all targets by a fixed percentage had to be employed. The targets are first, decreased to a level that is 15 percent below the base targets and then, increased to a level that is 15 percent above the base targets. The comparisons of costs, allocations of inputs, and shadow prices are shown below.

The objective function value at the lower base target level is \$b.3,251,990,878. This is a reduction of 19 percent over the objective function of the base targets. The value of the objective function for the higher base targets is \$b.4,965,635,695. This is an increase of 24 percent over the base target objective function. Since the production values move in constant increments of 15 percent while costs increase 19 percent from the lower base to the base level and 24 percent from the base to higher base level, there is an indication that total production costs are increasing at an increasing rate.

Tables 4.5 and 4.6 show the distribution of inputs by zone and the distribution of production by crop, by technology, and by zone when targets are decreased by 15 percent. Tables 4.7 and 4.8 list the distribution of inputs and production results for a 15 percent increase. In comparing these results with those of Tables 4.3 and 4.4, changes can be seen in both inputs and production.

The effects of the parametric changes on inputs of labor, fertilizer, capital and land are as expected, that is, they increase with incremental increases in the targets. Water is the only exception. This will be considered in the section dealing with irrigation.

The most noticeable changes in production occur in rice, corn, beef, sweet potatoes, barley, wheat, quinoa, cocaine, and sheep. At the lower base level, rice had a 10 percent shift of the production target from zone 7 to zone 1. It appears that when rice production under irrigation approaches 30,000 mt., the comparative advantage is overcome by production techniques in zone 7. Increasing production alters the distribution very little as Table 4.8 shows.

Corn is produced in four zones when the targets are at their base values. At the lower base values, an extra zone is brought into the solution. This extra zone (zone 5) has 29 percent of the total production. When higher production is demanded by the program (higher base level), apparently the comparative advantage is lost mostly to zone 1, while zone 6 gains some advantage, higher production is mostly produced in zone 1.

TABLE 4.5. Lower Base Run of Allocation of Inputs

Input / Zone	Labor $b*	Irrigation $b*	Fertilizer $b*	Capital $b*	Land 1 Ha.	Land 2 Ha.	Land 3 Ha.	Land 4 Ha.	Land 5 Ha.	Land 6 Ha.	Land 7 Ha.
1	48,708,800	864,023	---	32,077,397	28,125	22,944	621	347	4,000,000	---	---
2	57,200,700	---	---	89,828,500	9,194	3,519	40,699	4,711	2,000,000	---	---
3	23,020,500	---	23,600	24,512,813	16,840	2,907	1,095	---	---	---	---
4	223,743,000	9,180	1,247,934	535,359,500	12,077	12,267	139,480	52,309	---	8,500	---
5	303,929,000	8,820	---	61,902,000	115,529	323	6,035	56	15,633,600	---	---
6	195,947,000	3,652,192	1,494,632	325,636,200	413,678	---	1,891	---	---	64,495	---
7	68,057,100	---	1,388,045	66,575,400	50,720	4,140	---	44,170	3,000,000	---	---
8	24,477,200	---	799,000	24,533,400	64,819						220,000
9	69,891,200	11,668,451	---	117,944,000	324,474						1,400,000
10	58,220,500	89,685	797,200	7,160,828	1,993						3,793,906
TOTAL	1,073,195,000	16,292,351	5,750,411	1,285,530,038	1,037,449	46,100	189,821	101,593	24,633,600	72,995	5,413,906

*12 pesos = 1 dollar.

TABLE 4.6. Lower Base Level Distribution of Production Target Achieving Solutions by Technology and Zone

Crop	Target	Land Type	Zone	Technology[a]	Metric Tons	% of Target
Rice	77,548	2	1	0	7,535	10
			1	1	33,218	43
			2	0	5,314	6.5
			3	0	3,983	5
			4	0	20,854	27
			5	0	436	.5
			7	0	6,210	8
Corn	461,040	1	1	0	51,188	11
			2	0	15,354	3
			4	0	15,910	3
			5	0	132,848	29
			6	0	245,742	54
Corn Silage	8,500	1	7	0	8,500	100
Sugar Cane	2,525,512	3	1	0	12,420	.5
			2	0	1,302,368	52
			3	0	24,800	1
			4	0	1,148,350	45
			5	0	37,570	1.5
Bananas	269,911	4	2	0	14,299	5
			4	0	243,653	90
			7	0	11,960	5
Pineapples	850	4	1	0	357	42
			2	0	77	9
			4	0	196	23
			7	0	221	26
Beef	4,457,711*	5	1	0	800,000	18
			2	0	400,000	9
			5	0	2,657,712	60
			7	0	600,000	13
Coffee	12,750	4	1	0	128	1
			2	0	750	6
			7	0	11,985	93
Sweet Potatoes	285,647	1	3	0	235,760	83
			5	0	49,883	17
Tobacco	425	4	7	0	425	100
Cotton	42,500	3	3	2	142	.3
			4	0	4,290	10
			4	2	36,491	86
			5	0	1,578	3.7
Soybeans	11,900	3	4	0	11,900	100
Milk Cows	218,984	6	4	0	25,500	12
			6	0	193,485	88
Barley	81,152	1	8	0	49,267	61
			9	0	31,885	39
Barley Hay	205,711	1	9	0	205,311	100
Wheat	321,596	1	6	0	39,015	12
			6	3	79,807	25
			7	2	134,442	42
			9	0	13,810	4
			9	1	54,521	17
Quinoa	61,200	1	6	0	61,200	100
Peanuts	5,100	3	4	0	4,060	80
			6	0	1,040	20
Oranges	61,775	4	4	0	3,090	5
			5	0	3,696	6
			7	0	54,960	89
Coca Leaf	4,673	4	7	0	3,038	65
			7	0A	1,635	35
Sheep	2,706,953*	7	8	0	110,000	4
			9	0	700,000	26
			10	0	1,896,953	70
Potatoes	849,265	1	4	3	1,632	.2
			5	3	2,156	.3
			6	3	354,720	42
			6	3A	299,180	35
			7	3	7,497	.9
			8	3	19,176	2.3
			9	3	150,960	18
			10	3A	13,951	1.3

*Number of head.

[a]0 = traditional, 1 = traditional irrigation, 2 = fertilizer, and 3 = irrigation and fertilizer.

TABLE 4.7. Higher Base Run of Allocation of Inputs

Input Zone	Labor $b*	Irrigation $b*	Fertilizer $b*	Capital $b*	Land 1 Ha.	Land 2 Ha.	Land 3 Ha.	Land 4 Ha.	Land 5 Ha.	Land 6 Ha.	Land 7 Ha.
1	132,120,000	897,145	---	66,287,000	119,741	25,213	840	460	4,000,000	---	---
2	86,072,532	67,365	---	125,324,848	23,750	6,257	55,066	4,711	2,000,000	---	---
3	28,056,400	---	1,200	28,375,900	16,840	3,930	1,095	---	741,175	---	---
4	345,388,548	12,420	1,289,381	867,811,520	12,077	16,590	214,053	71,392	1,000,000	11,500	---
5	236,389,000	11,925	---	78,211,000	132,083	437	8,165	75	10,096,066	---	---
6	194,618,000	3,093,940	1,438,714	380,523,000	413,678	---	2,618	---	---	87,257	---
7	301,318,000	---	1,735,500	179,726,400	135,194	9,998	---	58,037	13,817,600	---	---
8	36,941,600	---	1,080,000	34,796,700	88,258	---					220,000
9	161,395,000	10,680,050	---	131,595,000	324,474				500,000		6,884,696
10	8,382,512	135,000	1,200,000	11,811,600	17,648				400,000		220,000
TOTAL	1,530,681,592	14,897,845	6,744,795	1,904,462,968	1,283,743	62,425	281,837	134,675	32,554,841	98,757	7,324,696

*12 pesos = 1 dollar.

TABLE 4.8. Distribution of Higher Base Level Production Target Achieving Solutions by Technology and Zone

Crop	Target	Land Type	Zone	Technology[a]	Metric Tons	% of Target
Rice	104,918	2	1	0	10,193	10
			1	1	34,491	32
			2	0	7,188	7
			2	1	2,994	3
			3	0	5,384	5
			4	0	28,203	27
			5	0	590	1
			7	0	8,400	8
			7	2	7,477	7
Corn	623,760	1	1	0	217,929	35
			2	0	39,663	6
			4	0	15,813	3
			5	0	143,579	23
			6	0	206,775	33
Corn Silage	11,500	1	7	0	11,500	100
Sugar Cane	3,416,870	3	1	0	16,800	.5
			2	0	1,762,112	52
			3	0	33,480	1
			4	0	1,553,650	45
			5	0	50,830	1.5
Bananas	365,173	4	2	0	13,030	4
			4	0	326,416	89
			7	0	24,150	7
Pineapple	1,150	4	1	0	480	42
			2	0	102	9
			4	0	263	23
			7	0	305	26
Beef	6,031,021*	5	1	0	800,000	13
			2	0	400,000	7
			3	0	111,176	2
			4	0	150,000	2.5
			5	0	1,716,337	28
			7	0	2,763,520	46
			9	0	50,000	.8
			10	0	40,000	.7
Coffee	17,250	4	1	0	168	1
			2	0	863	5
			7	0	16,219	94
Sweet Potatoes	386,463	1	3	0	235,760	61
			5	0	150,703	39
Tobacco	575	4	4	0	575	100
Cotton	70,000	3	3	2	7	--
			4	0	5,804	8
			4	2	62,055	89
			5	0	2,134	3
Soybeans	16,100	3	4	0	16,100	100
Milk Cows	296,272*	6	4	0	34,500	12
			6	0	261,771	88
Barley	109,794	1	8	0	67,115	61
			9	0	42,679	39
Barley Hay	278,315	1	9	0	278,315	100
Wheat	435,100	1	6	0	52,785	12
			7	2	363,639	84
			9	0	18,676	4
Quinoa	82,800	1	6	0	76,355	92
			10	0	6,445	8
Peanuts	6,900	3	4	0	5,460	79
			6	0	1,440	21
Oranges	83,577	4	4	0	4,200	5
			5	0	4,950	6
			7	0	74,400	89
Coca Leaf	6,323	4	7	0	4,688	74
			7	0A	1,635	26
Sheep	3,662,348*	7	8	0	110,000	3
			9	0	3,442,348	94
			10	0	110,000	3
Potatoes	1,149,005	1	4	3	2,208	.2
			5	3	2,915	.3
			6	3	479,880	42
			6	3A	402,696	35
			7	3	10,143	.9
			8	3	25,920	2.1
			9	3	204,240	18
			10	3A	21,000	1.5

*Number of head.

[a]0 = traditional, 1 = traditional irrigation, 2 = fertilizer, and 3 = irrigation and fertilizer.

Beef production has a small distribution at the lower base level where only four zones are involved. Dramatic changes occur at the higher base level which spreads production over eight zones. Many factors affect the distribution such as land development costs and labor availability for the different zones.

Sweet potatoes are produced in zones 3 and 5 at the lower base targets. Increasing production brings zone 6 into the solution. Zone 3 is constrained by labor and the cost involved in developing more land. Due to demand for labor and land by the other crops in zone 6, production is phased out at the higher base targets.

Barley is produced in zone 8 up to 49,000 metric tons then production switches to zone 9. Interestingly enough, at the higher base level, zone 8 regains the comparative advantage.

The distribution of wheat production shows little change until at the higher base level. Zone 7 reaches a level of production where land development is once again economical and the results have 84 percent of total production grown here. Unfortunately, the data cannot reflect the infrastructural problems and labor problems that would exist if the wheat target was attained by this distribution.

Quinoa appears well-adapted to zone 6 up to 76,000 metric tons. At the higher base level, zone 10 is able to compete for an increasing percentage of the production.

Coca leaf production results show one technology being assigned an increasing production percentage as the target levels increase (Table 4.8) due to the fact that the "Chapare" variety has a higher yield than the variety grown in the Yungas. The ratio is over 3 to 1 [15].

At the higher base targets, zone 10 rapidly loses its comparative advantage in sheep. The major cause of such a drastic shift in production areas at the higher base level is the fact that zone 10 is able to employ some of its resources better in production of quinoa, beef, and potatoes, whose processes are more capital intensive. The comparative advantage is lost in sheep because the zone is gaining advantages in other crops.

The remaining crops of corn silage, sugar cane, bananas, pineapple, coffee, soybeans, milk cows, barley, barley hay, peanuts, oranges, and potatoes show little or no change due to changes made in target values.

Sensitivity Analysis

A sensitivity analysis is a procedure that tests the range over which the column activities and elements of the right hand side (RHS) could vary without altering the optimal combination of inputs. The ranges are calculated by changing the slope of the iso-cost line until the optimal point would be changed by further slope variations and thus one side (limit) of the range is found. Reversing the slope change would locate the other limit and consequently the total range. The range in between the upper and lower limits defines the extent to which changes can be made in the coefficients or target values without causing a change in the objective function. The smaller the range, the more sensitive the objective function is to changes. Information is given that can be used to locate the variables that are the most sensitive. The study will rely on this technique to find the constraints that are the most restrictive and to test the technologies that would be most affected by variations in the prices of inputs. Insight is gained when establishing production targets because the more sensitive variables are exposed and further research can be specifically directed to their study.

Target Sensitivity

Sensitivity analysis of both the targets and the traditional technologies are performed by the program. Table 4.9 shows the results for the targets.

This table includes a sensitivity analysis at the lower and higher parametric steps which help to identify the trend of sensitivity. The crops are ranked according to their sensitivity starting with the most sensitive. Some crops, such as tobacco, are very sensitive at the lower base target value, less sensitive at the base level, and more sensitive at the higher base values. On the other hand, crops, like sheep, are less sensitive at the lower base level, more sensitive at the base level, and less sensitive at the higher base level. Examples of crops following these same trend lines are soybeans and peanuts.

Coffee is the most sensitive crop at the base level with a range of 16,638 mt. Examination of the range at each of the three target levels indicate that as the values increase, coffee production becomes very sensitive to small changes.

Coca leaf production is the next most sensitive having a range of 18,361 mt. The range increases from the lower base target value to the base level, then drops off to 14,850 mt. Input prices could have the largest variation at the base target level.

TABLE 4.9. Sensitivity Ranges for Targets

Target	Sensitivity Lower Base Level	Sensitivity Base Level	Sensitivity Higher Base Level	Range Lower Base Level	Rank of Most Sensitive	Range Base Level	Rank of Most Sensitive	Range Higher Level	Rank of Most Sensitive
Rice	63,766 492,238	80,306 130,655	89,863 222,535	428,472	7	50,349	3	132,672	11
Corn	433,733 712,765	474,821 566,330	599,451 695,156	279,032	9	91,509	9	95,705	10
Corn Silage	0 1,494,320	0 3,896,746	0 52,878	1,494,320	17	3,896,746	19	52,878	6
Sugar Cane	1,332,112 6,231,728	1,544,572 6,423,113	1,671,304 4,922,662	4,899,616	21	4,878,541	21	3,251,358	20
Bananas	87,711 731,526	88,797 633,266	305,287 525,510	643,815	13	544,469	14	220,223	14
Pineapple	630 82,958	741 76,588	845 14,826	82,328	6	75,847	8	13,981	3
Beef	4,342,844 5,232,337	5,170,867 5,271,057	5,919,845 6,069,845	889,493	15	100,190	10	150,000	12
Coffee	12,743 35,382	14,991 31,629	17,201 20,763	22,639	3	16,638	1	3,562	1
Sweet Potatoes	235,760 1,061,086	262,479 584,558	235,760 466,517	825,326	14	322,079	13	230,757	15
Tobacco	0 7,790	0 65,289	0 3,808	7,790	1	65,289	6	3,808	2
Cotton	12,541 90,629	13,341 82,918	14,137 75,009	78,088	5	69,577	7	60,872	9
Soybean	0 371,309	0 259,820	0 53,505	371,309	12	259,820	11	53,505	7
Potatoes	555,195 2,485,756	647,157 1,256,842	887,212 1,917,885	1,930,561	18	609,685	15	1,030,673	18
Oranges	6,786 2,413,118	7,994 1,800,391	9,150 216,055	2,406,332	19	1,792,397	18	206,905	13
Milk Cows	89,357 40,424,400	78,453 40,457,500	91,044 31,021,300	40,335,043	22	40,379,047	22	30,930,256	22
Peanuts	5,078 1,373,157	6,000 1,373,869	6,835 1,052,370	1,368,079	16	1,367,869	17	1,045,535	19
Barley Hay	43,617 365,079	0 276,066	187,145 458,516	321,462	10	276,066	12	271,371	16
Barley	49,267 118,897	47,388 103,538	88,201 563,561	69,630	4	56,150	5	475,360	17
Wheat	266,143 630,191	241,111 1,602,028	397,796 448,127	364,048	11	1,360,917	16	50,331	5
Quinoa	44,816 208,645	31,453 86,358	68,214 125,638	163,829	8	54,905	4	57,424	8
Coca Leaf	4,670 22,223	5,494 23,855	4,670 19,520	17,553	2	18,361	2	14,850	4
Sheep	920,000 5,245,134	920,000 5,121,934	920,000 22,959,800	4,325,134	20	4,201,934	20	22,039,800	21

The range for rice is considerably larger than for coffee and coca leaf. At the lower base level, the range is 128,472 mt., it declines to 50,349 mt. at the base level, and then increases to 132,672 mt. at the higher base level. Indications are that rice sensitivity bottoms out close to the base target level then appears to become less sensitive as production targets increase.

Quinoa, beef, and corn seem to follow the same pattern. That is, they have a high range at the lower base levels, then decrease considerably when at the base targets, and increase slightly at the higher base levels. The sensitivity rank of each can be seen in Table 4.9.

Bananas, sweet potatoes, cotton, peanuts, and barley hay are least sensitive at the lower base target levels, increase sensitivity at the base levels, and become moderately more sensitive as the target levels increase.

Tobacco is very sensitive at the lower base level having a range of only 7,790 mt. When the target is at the base level, it is less sensitive to changes dropping to the rank of 6. Further target increases cause the crop to become even more sensitive than at the lower base level. Corn silage and wheat seem to follow this same general pattern.

The pattern for pineapple, soybeans, and oranges indicates a low sensitivity lower base level, shows increased sensitivity at the base level, and sharply increases in sensitivity as the target level of each crop increases.

The sensitivity of barley and sheep targets seems to increase up to the base level and then a large increase in relative range size occurs; both crops become highly insensitive as target values increase. Potato has a somewhat similar pattern with the exception that it becomes only moderatly insensitive at the higher base level.

Sugar cane has a large range at each of the three levels. It appears to be slightly increasing in sensitivity at the higher base levels but the change is gradual. Minor changes in inputs seem unlikely to influence the cost of achieving the target.

The least-sensitive target is milk cows. Though the range decreases to 30,930,256 head at the higher base level, it seems very unlikely that target costs would be noticeably affected by changes of 30 to 40 thousand head in the target values.

Policy Implications

Public planners should be aware of the implications caused by using different policy instruments. Accomplishing production goals depends a lot on the way that available instruments are used. Policy-makers should also be alert to the fact that targets transform into instruments through time. In the present study, the time period is long enough that target values will have an effect on Bolivia's total welfare function (W). Common policy instruments such as taxes, production quotas, etc., cannot be implemented in isolation. Establishment of their various levels must be coordinated with the setting of target levels. Planners should be aware of target sensitivity in order to avoid unnecessary resource costs. For example, cotton production is on the upswing. The planners could encourage more production by lowering export taxes and/or establishing price supports. Comparative advantage may depend entirely on the cost of production (resource costs). Increments in the target value indicate that the range of sensitivity is narrowing. Policy-makers that set the target high enough so that production costs change may cause the comparative advantage of cotton to disappear. If the policy is continued, resource costs would mount which is an especially serious problem for a developing agriculture with very limited resources.

Traditional Technology Sensitivity

For some crops, traditional technology is the most productive and best utilizes input resources. Table 4.10 lists the traditional technologies where reduction in costs (or) increased yields is necessary to enable them to compete for production resources. The zones that show present cost equal to competitive cost are crops where traditional technology is the most efficient of all available technologies. Due to lack of space, the noncompetitive higher technologies were not included in Table 4.10. In addition, the list covers only those crops that have two or more hypothetical technologies.

The traditional technologies that show advantages, in relation to cost and yield, over higher technologies are: sugar cane production in zone 2, pineapple production in zone 7, coffee production in zone 7, peanut production in zone 6, and orange production in zone 7. Traditional technologies are not competitive in rice, cotton, potato, and wheat production. The cost of traditional rice production has to decrease by \$b.168 to a level of \$b.1,359 per hectare before zone 4 could compete for resources using traditional technologies. Traditional

TABLE 4.10. Cost Reductions per Hectare that Enables Traditional Technologies to Compete for Resources

Crop	Zone	Present Cost	Competitive Cost at Lower Base	Competitive Cost at Base	Competitive Cost at Higher Base
			---------$b/Ha.*---------		
Rice	1	1,467	610	582	366
	2	1,503	1,172	1,184	1,242
	3	1,503	1,027	1,038	1,125
	4	1,523	1,345	1,359	1,467
	5	1,503	973	925	997
	7	1,457	1,170	1,173	1,153
Sugar Cane	1	2,409	1,100	456	267
	2	2,409	2,409	2,409	2,409
	3	2,409	-1,176[a]	-1,176	-1,176
	4	2,409	-893	-893	-893
	5	2,409	-1,067	-1,100	-1,107
Pineapple	1	1,588	1,214	1,205	1,042
	2	1,854	669	683	1,038
	4	1,854	529	545	1,255
	7	1,588	1,588	1,588	1,588
Coffee	1	746	515	497	357
	2	746	308	309	663
	4	746	-658	-658	47
	7	746	746	746	746
Cotton	3	3,293	1,340	1,340	1,340
	4	3,293	971	971	971
	5	3,293	-170	-214	-225
Potatoes	4	3,211	394	386	324
	5	3,211	1,233	1,198	1,192
	6	2,343	2,056	2,053	2,034
	7	3,343	711	694	780
	8	1,935	296	277	-251
	9	1,872	1,111	1,113	1,063
	10	1,722	1,689	1,696	1,693
Wheat	6	515	172	158	23
	7	562	-260	-266	-269
	9	447	355	354	258
Peanuts	4	1,553	535	535	535
	6	1,191	1,191	1,191	1,191
Oranges	4	1,739	-706	-706	-1
	5	1,739	1,519	1,441	1,435
	7	1,973	1,973	1,973	1,973

*12 pesos = 1 dollar

[a]The negative sign doesn't mean the technology is unprofitable only that it cannot compete with traditional methods under present costs and yields.

cotton production needs to decrease by \$b.1,953 to \$b.1,340 per hectare before zone 3 can produce cotton. Only a \$b.26 reduction in potato production is needed before zone 10 can compete. The cost per hectare would have to be \$b.1,696. Zone 9 could produce wheat if it is possible to reduce traditional costs \$b.304 per hectare. All of the above costs assume yields of all technologies to remain at their present levels.

Investment Criteria

As was shown earlier, the agricultural sector receives limited public and private funds for development. The fact that funds are limited makes it more important that they be employed in the most positive way possible. Efficiency of investment dictates that priorities be set. A capital budgeting technique that ranks investments is explained below [16, Chapter 8].

The program derives a shadow price for each target at each level studied. These shadow prices are shown in Table 4.11. The program lists the values as negative numbers. The LP Model interprets negative shadow prices as the change that would occur in the objective function if one less unit is produced. Since an upper range exists for every target studied, the shadow prices could be interpreted as the cost of adding one more unit of a given crop. For instance, if one more unit of rice is desired at the higher base level, the cost would be \$b.1,107.

Capital budgeting decisions should allocate capital to result in maximization of returns. The present value (PV) of income must exceed

TABLE 4.11. Shadow Prices of Targets

(Bolivian pesos)

Target	Initial Run	Lower Base Run	Base Run	Higher Base Run
	$b*			
Rice	-1,034	-1,034	-1,042	-1,107
Corn	-901	-901	-914	-1,019
Corn Silage	-131	-136	-137	-137
Sugar Cane	-163	-163	-163	-163
Bananas	-394	-394	-394	-394
Pineapple	-681	-717	-722	-723
Beef	-105	-102	-107	-108
Coffee	-1,075	-1,092	-1,094	-1,101
Sweet Potatoes	-280	-293	-298	-306
Tobacco	-8,029	-8,435	-8,485	-7,651
Cotton	-22,462	-22,462	-22,462	-22,462
Soybean	-10,725	-10,725	-10,725	-10,725
Milk Cows	-850	-1,638	-1,638	-1,638
Barley	-1,412	-1,422	-1,431	-1,647
Barley Hay	-335	-337	-339	-390
Wheat	-1,201	-1,255	-1,261	-1,263
Quinoa	-1,365	-1,405	-1,427	-1,602
Peanuts	-3,811	-3,981	-3,981	-3,981
Oranges	-26	-27	-27	-27
Coca Leaf	-2,278	-2,448	-2,469	-2,470
Sheep	-34	-34	-34	-34
Potatoes	-322	-338	-339	-349

*12 pesos = 1 dollar

the present value of investment expenses before an investment should even be considered. Since more than one investment plan may have a PV of income exceeding PV of expenses, one criterion would be to rank the investments according to the difference between PV of income and expenses. The important stipulation being that allowance be made for investments with different economic lives. Since the study considers investments with equal economic lives, this stipulation can be ignored.

Investment criteria establishes target priorities for the crops included in this study. The present value formula for annuities is used; $P(i,n) = F_n \frac{1 - (1+i)^{-n}}{i}$ where $P(i,n)$ is the present value of the investment (outflow), F_n is the net inflow per period, n is the number of periods (years), and i is the discount rate [14, p. 636].

The period of time selected is eleven years (1973 through 1984) and the discount rate chosen is 15 percent. The shadow prices are interpreted as the investment in inputs (land, labor, capital, water, and fertilizer) required to produce one more unit of output. Costs of production per unit are subtracted from gross income per unit per period of time. Prices of inputs and outputs are assumed to be fixed at their 1972 levels for the entire length of the investment. However, this assumption is not an absolute requirement. Price variations and interest rate fluctuations can be substituted in the calculations. The difference of the PV of income over expenses is the criteria for ranking investments.

Present values of the outflows in Table 4.12 are taken at higher base target levels. The capital budgeting process (which assumes limited funds) assigns coca leaf production the highest priority for

TABLE 4.12. Investment Priorities Using Net Present Value

Crop	Present Value Outflow*	Present Value Inflow	Net Present Value	Investment Priority
	-------------------------$b**-------------------			
Coca Leaf	2,470	43,377	40,907	1
Coffee	1,101	23,714	22,613	2
Tobacco	7,651	26,483	18,852	3
Peanuts	3,981	17,224	13,243	4
Cotton	22,462	28,299	5,837	5
Potatoes	349	5,888	5,539	6
Wheat[a]	1,263	6,699	5,436	7
Pineapple	681	5,288	4,607	8
Oranges	27	3,360	3,333	9
Quinoa	1,602	4,815	3,213	10
Beef[b]	108	2,884	2,776	11
Corn	1,019	3,350	2,331	12
Bananas	394	1,927	1,533	13
Rice	1,107	2,282	1,175	14
Beef[c]	108	1,277	1,169	15
Sweet Potatoes	306	1,261	955	16
Sheep	34	734	700	17
Barley	1,647	2,203	556	18
Wheat[d]	1,263	1,403	140	19
Sugar Cane	163	267	104	20
Barley Hay[e]	390	390	0	--
Milk Cows[f]	1,638	1,638	0	--
Corn Silage[g]	137	78	(59)	--
Soybean[h]	10,725	9,829	(896)	--

*Present values of outflows are taken at the higher base target values.

**12 pesos = 1 dollar

[a]Priced at $b95 cwt., price for first two quarters of 1973.

[b]Priced at FAO price of $US 227 per ton.

[c]Priced at estimated $b.614 per head allowing 50 percent waste.

[d]Priced at $b.45 cwt., 1972 price.

[e]No available price, to break even must receive price of $b.375 per metric ton.

[f]No available price, to break even must receive price of $b.1,112 per head.

[g]Investment not advisable; need a price of $b.263 per metric ton to break even.

[h]Investment not advisable; need a price of $b.3,141 per metric ton to break even.

investment. In order to achieve the production targets at least-cost, investment in crop inputs should be injected according to their priority rank.

The process for deriving the rank of peanuts can be used as an example. The shadow price of peanuts is $b.3,981, and consequently, the initial investment required to produce one additional metric ton. The variable cost of production for one metric ton is $b.1,109, while the price per metric ton is $b.4,400 (Bolivian price). This indicates a net income of $b.3,291 per year for eleven years. Multiplying the net income by the factor of 5.2337 creates a present value of income of $b.17,224. The difference of the PV of income and PV of initial investment is $b.13,243 which ranks peanuts number 4 [Table 4.12].

All investments having a present value greater than zero can be undertaken if there are adequate monies. An interesting feature is the change in the position of wheat and beef when calculated at 1972 prices versus 1973 prices. Wheat is ranked 19th at 1972 prices but rises to 7th place when 1973 prices are used. Beef moves from 15th place to 11th place, respectively, when 1973 prices are substituted.

It is impossible to investigate the effect that different import-export policies have on investment priorities due to lack of data. Suggested investment rankings would remain unchanged if existing policies do not differentiate market conditions for the commodities under consideration. On the other hand, discriminating policies that favor some commodities over others will cause investment priorities to change depending on the crops involved and the extent of favoritism.

For example, if domestic wheat production is favored by relaxing export taxes and/or imposing import quotas, investment in wheat production would receive higher priority. The domestic returns of other crops may be more profitable than returns from wheat, but import and export policies favoring wheat production in relation to other crops close the gap between their returns. Returns to wheat do not necessarily increase but costs of other crops are increased because of favoritism and wheat becomes a more favorable investment.

When considering import and export policy, each situation should include assessment of home production versus importation and whether other crops that would earn more foreign exchange are passed over if importation or exportation of a particular commodity is pushed.

Actual investment procedures depend not only on the rank of the production target, but, also on the total welfare function (W) of the people and the various political goals.

Returns to Irrigation

Irrigation is considered in two ways. The first consideration of irrigation development takes the form of an extension of the present traditional practice of diverting water from small rivers and streams. Many communities combine their labor resources and, to some extent, their capital resources (shovels and picks) to construct water diversion channels in adjacent streams. The diverted water is sent through a system of crude ditches which distribute the water according to prespecified community agreements.

Present-day production techniques include irrigation to a limited extent. Small, localized communal systems exist for farms located near accessible water. The farming ground situated on higher hillsides and the Altiplano (high plain) has little chance for feasible irrigation. These crops are cultivated depending only on rainfall. In lower, wet climates, satisfactory yields are obtained without irrigation. Other reasons for lack of irrigation in the lowlands are the large amount of capital needed to develop it and that the land is too flat to take advantage of traditional diversionary practices.

A sample cost budget was developed for an Altiplano community in zone 8. The budget is to obtain supplemental water for approximately 260 hectares in a system with 170 farmers. The wages for a day's work was found to be 12 pesos (1 peso equals U.S.$.05). Each spring a dike has to be built in the river and the ditches have to be cleaned. This work can be accomplished in three days per outing and the work is required twice a year. The purpose of constructing the budget in Table 4.13 is to estimate a traditional irrigation coefficient employed in the matrix of the LP Model.

Though no money is exchanged in this communal enterprise, the opportunity cost of developing irrigation for one hectare is $b.47.59. The opportunity cost of labor is, in essence, the total implicit cost of getting water to the farmer's field.

Comparisons are made between the coefficient derived from the budget (Table 4.13) and coefficients from other sources [11] in order to estimate a value between $b.45 and $b.52, as the traditional irrigation coefficient for the program. The range is established due to varying labor costs among zones.

TABLE 4.13. Cost of Traditional Irrigation Development Per Hectare for Zone 8

Item		
6 days/year	x $b.12/day	= $b.72/year/person
$b.72/year/person	x 170 people	= $b.12,240/year
$b.12,240	÷ 260 hectares	= $b.47/hectare
Cost of tools		= $b.200/5 years
Amortized at 12 percent		= $b.55/year
$b.55/year	÷ 360 days	= $b..15/day
$b..15/day	x 6 days/year	= $b..90/person
$b..90	x 170 people	= $b.153/year
$b.153/year	÷ 260 hectares	= $b..59/hectare
$b.47/hectare	+ $b..59/hectare	= $b.47.59/hectare

The second consideration of irrigation is the capital-intensive development of water where it is feasible. The government has built dams in Cochabamba and Oruro that serve about 7,000 hectares. A few large private enterprises have projects near Santa Cruz and Tarija which employ river pumps and a network of canals. Experimentation has been done with sprinkler systems on a few of the commercialized farms. Presently, most systems pump from nearby rivers. Sizeable amounts of capital are required for installation and operation of these types of systems.

Specific returns to irrigation were calculated for wheat in zones 6 and 9, and rice in zone 1. These crops and zones are selected because of suggested present production practices of these crops in these zones. The average internal rate of return for wheat in zone 6 without irrigation is 15.4 percent per hectare while with irrigation, it is 22.2 percent per hectare showing a difference of 6.8 percent per hectare. Additional inputs of labor and capital are required as a result of applying irrigation. The 6.8 percent reflects the extra returns attributable to the irrigation technology.

Costs of production budgets were used to calculate the average internal rate of return for the two technologies. Average internal rates of return (IRR) were calculated from the present value formula described on page 80. Solving for the factor $\frac{1-(1+i)^{-n}}{i}$ gives the average internal rate of return. In considering the irrigation technology of wheat, the investment P(i,n) is \$b.624 (cost of production), the net returns F_n are \$b.158, and n equals 11. The resulting factor is 3.949 and the average internal rate of return of 22.2 percent is found on the corresponding present value table [14, p.636].

Wheat in zone 9 showed an IRR of 1.8 percent and 18.8 percent on traditional and irrigated technologies, respectively. The difference of 17 percent is credited to irrigation.

The initial run solution indicates that 81 percent of rice production should take place in zone 1. IRR for traditional production is 36 percent while irrigation has an IRR of 45 percent. Water application could increase returns by 11 percent. Production cost data for traditional irrigation practices suggest returns to water are favorable in this technology.

Present data suggest that capital intensive irrigation is practical in many regions. The base run program assigns only zone 6 for feasible capital intensive irrigation. Almost total exclusion of this technology occurs because production costs are higher (net returns are lower) in relation to alternative technologies. Comparing net returns of capital intensive irrigation methods to other production technologies is possible from data constituting present costs of production budgets. Comparisons are made for wheat production in zone 6 and rice production in zone 4.

Average rate of return (average net returns) are calculated from the previously defined present value formula on page 80. For intensive capital irrigation of wheat in zone 6, the cost and net returns for one hectare of production per each time period (1 year) are \$b.1,738 and \$b.876, respectively. The average internal rate of return (IRR) is 50 percent. For traditional and traditional irrigated, the costs are \$b.515 and \$b.624, net returns are \$b.79 and \$b.138, resulting in 15 percent and 22 percent as their respective IRR. The data suggest capital intensive irrigation to be the most efficient.

Rice production in zone 4 has different results. Traditional practices have a cost of \$b.1,523 and average net returns of \$b.721 per hectare for each period in the study. The IRR is 47 percent. Capital intensive irrigation methods have a cost of \$b.2,051 and average net returns of \$b.524 for an IRR of 25 percent. This is lower than returns from other rice production methods, and consequently, never enters the program solution.

Wheat and rice production costs and returns are but two of the many conflicting examples. Capital intensive irrigation production costs and returns need more study of the coefficient values for the various crops before a definite conclusion can be reached as to its relative efficiency.

Table 4.14 isolates irrigation investment by zone. Capital intensive and traditional irrigation technologies are the basis by which the different computer runs assign production to crops and zones. Values used in the table are taken from either the initial run, base run, lower base run, or higher base run. Total projected irrigation investment at the initial run is $b.14,648,368. In the base run, bounding of traditional technologies [Appendix III] cause total projected investment to decrease. This is as expected because more production is assigned to traditional methods which use no irrigation, which is as expected.

Lowering the targets and bounds by the same percentage, results in higher irrigation investment. The reason for this abnormal behavior lies in zones 1, 6, and 9. Zone 1 produces more irrigated rice because the lower bounds left a larger quantity available for optimum allocation.

The higher base run was expected to project the largest total irrigation investment. Increasing the targets and bounds by the same percentage results in more irrigation investment than the initial or base runs but less than projected investment contained in the lower base run. Zones 6 and 9 account for the difference between the lower base and higher base runs. Production of wheat by irrigation in zone 6 reached a point where it was cheaper to produce in zone 7 due to lower costs thus phasing out the entire zone 6 irrigation technology. Zone 9 faces the same situation as irrigated wheat production is phased out and shifted to zone 7. The shift was large enough to reduce investment by $b.1.4 million. Zone 7 does not use water as a

TABLE 4.14. Irrigation Investment by Zone and Target Level

Computer Run \ Zone	1	2	4	5	6 $b*	9	10	TOTAL
Initial	1,931,005			128,856	5,645,592	6,942,915		14,648,368
Base	789,776		10,800	10,350	3,524,621	10,093,530	105,525	14,534,602
Lower Base	864,023		9,180	8,820	3,652,192	11,668,451	89,685	16,292,351
Higher Base	897,145	67,365	12,420	11,925	3,093,940	10,680,050	135,000	14,897,845

*12 pesos = 1 dollar

controlled input due to climatic conditions. Labor, capital, and fertilizer are the inputs used to produce wheat in this zone resulting in substitution between fertilizer and irrigation in the higher base run [see Tables 4.5 and 4.7].

Irrigation potential is present in the production processes for some of the important Bolivian crops. Irrigation seems to show major benefits in achieving the targets of rice, wheat, and potatoes. Assuming that resources follow the suggested allocation in the initial runs [Table 4.2], irrigation would account for 81 percent of the rice target, 64 percent of the wheat target, and 100 percent of the potato target. This program run indicates that the marginal rate of transformation should be directed to incorporating irrigation practices. Confidence in the direction of the switchover (MRT) is obscured in the other three runs due to the involvement of artificial bounds.

Future development of irrigation depends on two things. The subsidization of projects by the government and the rate of capital aggregation by the many communal systems enabling them to initiate capital intensive irrigation systems which would increase crop returns.

CONCLUSIONS AND RECOMMENDATIONS

All analytical results are a direct function of the quality and quantity of the data available and of the intrinsic characteristics of linear programming. This must be borne in mind when interpretations are made.

Conclusions

1. The direction of the marginal rate of transformation (MRT) is controlled by target values. For example, policies that set target values are critical because they affect the rate of development.

2. Land development is important to increase production in spite of the fact that increases can be expected from higher technology. $Land_1$ should be developed in zones 1, 7, and 8. $Land_2$ should be developed in zone 1, $land_3$ in zones 1, 2, 4, 5, and 6. $Land_4$ should be developed in zone 4, $land_5$ in zone 5. $Land_6$ should be developed in zones 4 and 6, and $land_7$ should be developed in zone 10.

3. The coefficients in the production processes for coffee, coca leaf, rice, quinoa, barley, tobacco, cotton, pineapple, and corn all have sensitivity ranges under 100,000 mt. (base run). This indicates that extra care should be taken in setting policies for these crops until more uncertainty can be removed about the true values of their production coefficients. Milk cows, sugar cane, sheep, and corn silage are the least sensitive to production coefficient changes.

4. New technologies which include irrigation, fertilizer, or both, will produce rice, cotton, potatoes, peanuts, and wheat at less resource cost once the initial investment is made. Investments should (a) establish and improve irrigation systems, and (b) improve or subsidize distribution and transportation costs of commercial fertilizer.

5. Linear programming can be used as one guide to establishing investment priorities.

6. Results for zone 7 are biased for many crops because physical limitations are not taken into account in calculation of many crop coefficients. However, if the interpretation of these particular results are viewed from the perspective of development in the Chapare region, zone 7 results are quite informative.

7. Zones 4 and 6 are the largest producers of crops while zone 7 has great potential if infrastructural problems can be overcome. Most beef should be produced in zone 5, sheep in zones 9 and 10, and milk cows in zone 4.

8. The optimal solution requires labor to shift from zones 8, 9, and 10 to zones 4 and 5. Though zone 6 is a high user of labor, there seems to be an adequate number of current workers in the zone. Immobility of this factor results in higher production costs.

9. Capital substitution is very competitive with labor from surrounding zones. This is especially evident in zone 4 in the production of cotton, soybeans, and milk cows. Zones 6 and 9 also show potential for sizeable substitution of capital for labor.

10. Fertilizer should be incorporated into many production technologies. It is especially effective for rice and wheat in zone 7, cotton in zones 3 and 4, and potatoes in zones 4, 5, 6, 7, 8, 9, and 10.

Natural fertilizer is effective for wheat in zone 6 and potatoes in zones 4, 5, 6, 7, 8, 9, and 10.

11. Traditional irrigation is productive and should be encouraged in zones 6 and 9. Results from trying to make allowances for capital intensive irrigation are inconclusive.

Recommendations

It is recognized that the research reported herein is not all encompassing -- the main virtue is the flexibility of the approach and the rapidity of analysis as policies change and prices fluctuate. As a continuation of the work, it is recommended that:

1. Careful study be given to securing more reliable data concerning costs, yields, and commodity prices of the traditional and newer technologies in order to make meaningful comparisons.

2. Establishment of a continuous data gathering system be started in order to keep up-to-date values of the present coefficients.

3. Production of alternative crops be studied and considered as world economic conditions change.

4. Water and fertilizer subsidization be given careful study. The program should be flexible among crops and only exist until peasant farmers have adequate capital for these inputs.

5. Extensive study be given to existing agricultural controls and taxes in connection with different crop targets to determine existing conflicts.

6. Refinement of production and consumption studies be performed in order that relevant targets can be established.

7. Costs of importing specific crops as compared to domestic production be given more study. Comparative advantages of other crops should be considered.

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APPENDIX A:

LABOR TRANSFER COSTS

Some zones will not have enough labor to enable them to meet the production targets, while others will have surplus labor after achieving the targets. The LP model moves the surplus labor to deficit labor zones. The cost of transferring labor among zones is based on (a) the distance between transferring zones, and (b) costs of relocation. As the distance from one zone to another increases, the supply of labor becomes more inelastic. Figure A.1 represents a situation where zone 1 requires outside labor to meet its production targets. The quantity of labor offered from surrounding zones is based on their respective marginal factor costs. Based on the equation $MFC = P_{1m}(1+\frac{1}{\Sigma})$ where MFC is the marginal factor cost of labor, P_1 is the price labor in zone m, and Σ is the elasticity of labor supply, MFC curves can be constructed.

SS is the labor supply curve for zone 1. TT is the target amount of labor. This is the number of workers needed to satisfy the labor requirement to enable production of the different crops that comply with the optimal target allocation solution. The number of laborers in zone 1 totals only 200. The optimal solution shows that costs would still be minimized if labor is imported from surrounding zones to reach the requirement of 600. Such an allocation would cause the price of zone 1 labor to increase. Assuming 200 is the total of able-bodied workers at any price, construction of marginal factor cost curves is possible. Lines MF2 to MF10 represent the extra cost above present wage levels that would attract labor from zones 2 to 10. Figure A.1 shows the MFC curves to slope upward to the right. Actually, the curves would be step increments such as the increment in wages shown by SS. The required 600 can only be achieved through higher

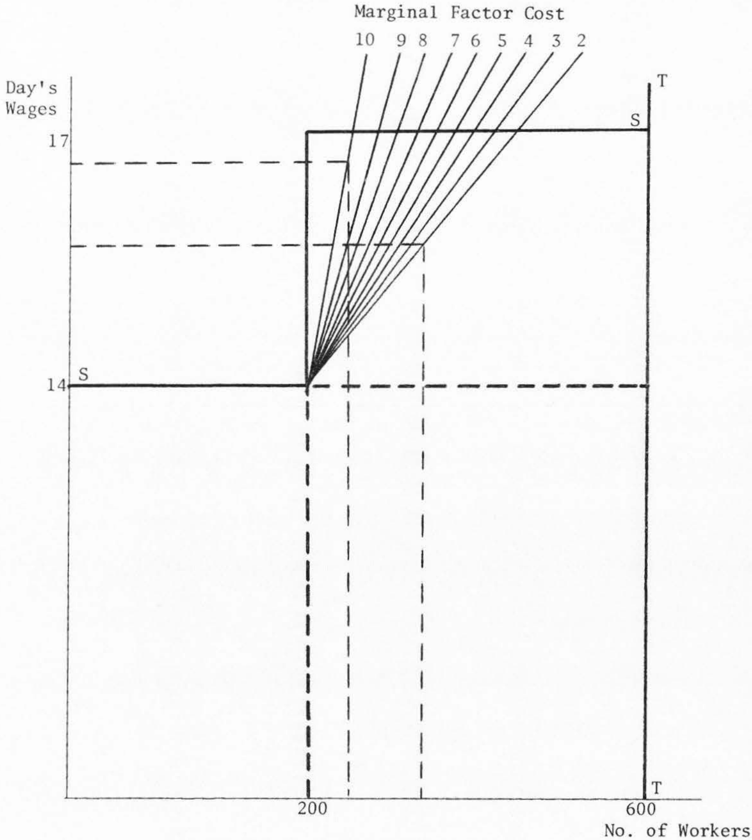

Figure A.1. Target Value and the Supply of Labor

labor costs throughout zone 1. Theoretically, this could be at the higher level of $b.17 per day.

Based on distance and relocation costs, the following matrix was constructed of MFC to and from any zone.

Labor transfer matrices were built into the program for each zone based on the logic developed by Figure A.1. The costs used in the program involving labor transfer to and from each zone are shown in Table A.1.

TABLE A.1. Marginal Factor Cost Matrix for Labor

Zone	Daily Wages ($b)	Zones									
		1	2	3	4	5	6	7	8	9	10
1	12		14	16	20	21	22	14	14	16	22
2	13	14		15	17	20	21	14	14	15	21
3	13	16	15		16	15	18	16	20	17	18
4	15	20	17	16		16	17	17	18	18	19
5	14	21	20	15	16		16	18	21	19	18
6	13	22	21	18	17	15		14	15	14	15
7	12	14	14	16	17	17	14		16	16	18
8	12	14	14	20	18	21	15	16		14	16
9	12	16	15	17	18	19	14	16	14		14
10	12	22	21	18	19	18	15	18	16	14	

APPENDIX B:

AGRICULTURAL EXPORTS, IMPORTS, AND BALANCE OF TRADE

TABLE B.1. Exports of Principal Agricultural Goods, Total Exports, and Agricultural Exports as a Percentage of Total Exports, Bolivia, 1951 - 1972

(1,000 Current U.S. Dollars)

Year	Principal Agricultural Exports[a]	Total Exports	Principal Agricultural Exports as % of Total
1951	$ 4,195	$ 150,590	2.8
1952	3,185	141,303	2.3
1953	2,205	112,664	2.0
1954	2,447	99,453	2.5
1955	2,056	102,374	2.0
1956	3,891	107,437	3.6
1957	3,595	97,667	3.7
1958	2,916	64,737	4.5
1959	5,292	77,635	6.8
1960	4,344	67,828	6.4
1961	4,604	76,136	6.2
1962	4,425	76,123	5.8
1963	3,943	86,403	4.6
1964	5,060	113,866	4.4
1965	5,957	131,836	4.5
1966	11,857	150,436	7.9
1967	11,714	166,325	7.0
1968	7,736	170,649	4.5
1969	7,530	198,191	3.8
1970	9,986	225,590	4.4
1971	17,929	215,914	8.3
1972	25,011	253,949	9.8

[a] Includes live cattle and meat products, Brazil and other nuts, coffee and cacao, leather and hides, coca, rubber, wood, vicuna, llama, sheep, alpaca and other wool, cotton, sugar, fresh fruits, and quinine, and other medicinal seeds and bark.

Source: CONEPLAN, Instituto Nacional de Estadística, Anuario de Comercio Exterior de Bolivia (La Paz: CONEPLAN, 1951-1970); unpublished data of CONEPLAN, Instituto Nacional de Estadística for 1971, and estimates by Dirección General de Comercio Exterior of the Ministerio de Industria, Comercio y Turismo for 1972.

TABLE B.2. Exports of Principal Agricultural Commodities from Bolivia 1951-1972

(1,000 Current U.S. Dollars)

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961
Cattle[a]	209	224	195	136	118	107	84	7	115	68	99
Nuts[b]	53	254	134	492	360	1,094	527	414	1,272	1,508	1,563
Coffee[c]	---	---	157	268	75	77	558	533	595	786	819
Hides[d]	1,506	987	720	358	359	960	1,103	611	797	442	360
Coca Leaf	191	467	481	685	191	62	359	166	22	144	191
Rubber	1,716	920	318	393	670	886	535	569	1,294	969	948
Wood[e]	504	309	184	106	60	142	101	137	442	281	394
Wool[f]	11	22	16	9	222	557	327	476	732	123	218
Cotton	---	---	---	---	---	---	---	---	---	---	---
Sugar	1	---	---	---	---	---	---	---	---	---	---
Fresh Fruits	---	---	i	i	---	7	i	4	9	18	---
Quinine[g]	4	3	---	---	---	---	i	i	13	4	12
Total	4,195	3,185	2,205	2,447	2,056	3,891	3,595	2,916	5,292	4,344	4,604

TABLE B.2. (Continued)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Cattle[a]	116	157	154	191	117	1	4	20	46	3,766	4,078
Nuts[b]	1,402	611	359	457	1,083	2,561	890	865	1,092	1,224	1,264
Coffee[c]	1,023	957	2,241	1,161	4,919	4,509	2,656	2,909	3,647	3,557	4,683
Hides[d]	483	1,017	1,154	1,428	1,489	1,176	814	580	449	557	731
Coca Leaf	118	61	104	81	---	6	---	2	56	89	848
Rubber	839	555	625	762	613	736	493	665	842	847	771
Wood[e]	296	193	38	168	485	651	890	1,190	1,963	2,877	3,800
Wool[f]	137	372	340	218	218	75	30	16	16	13	261
Cotton	---	---	---	i	i	6	343	317	749	3,941	7,557
Sugar	---	---	---	414	588	731	845	860	984	937	932
Fresh Fruits	4	2	25	32	78	105	54	64	102	115	82
Quinine[g]	7	19	21	1,045	2,267	1,158	718	42	40	6	4
Total	4,425	3,943	5,060	5,057	11,857	11,714	7,736	7,530	9,986	17,929	25,011

TABLE B.2. (Continued)

[a]Live cattle, dried meat, and fresh meat through 1964; live cattle and dried meat after 1964.

[b]Brazil nuts and almonds.

[c]Coffee and cacao until 1965, coffee only from 1965 on.

[d]Cattle, reptile and other hides and bristles after 1956.

[e]Lumber and posts.

[f]Vincuna, alpaca, sheep and llama.

[g]Includes other medicinal seeds and bark.

[h]Components may not add to total due to rounding.

[i]Less than $449.

Source: CONEPLAN, Instituto Nacional de Estadística, Anuario de Comercio Exterior de Bolivia (La Paz: CONEPLAN, 1951-1970); unpublished data of CONEPLAN, Instituto Nacional de Estadística for 1971 and estimates by Dirección General de Comercio Exterior of the Ministerio de Industria, Comercio y Turismo for 1972.

TABLE B.3. Imports of Principal Agricultural Commodities, of Total Imports, and of Agricultural Imports as a Share of the Total, Bolivia, 1951-1971

Year	Food Products	Raw Materials of Agricultural Origin	Inputs for Agriculture	All Agricultural Imports[b]	Total Imports	Agricultural Imports as a % of the Total
1951	$ 24,333	$ 5,444	$ 1,092	$ 30,869	$ 85,838	36.0
1952	26,862	4,040	1,096	31,998	92,620	34.6
1953	25,320	3,165	1,288	29,773	68,006	43.8
1954	22,985	4,363	831	28,179	65,483	43.0
1955	24,895	4,889	2,773	32,557	82,394	39.5
1956	21,622	3,906	5,756	31,284	84,058	37.2
1957	27,747	5,030	1,376	34,153	90,288	37.8
1958	17,303	3,734	1,475	22,512	79,612	28.3
1959	16,109	1,602	801	18,512	64,986	28.5
1960	14,817	7,199	1,184	23,200	71,462	32.5
1961	19,040	4,920	846	24,806	77,686	31.9
1962	24,725	3,113	958	28,796	96,926	29.7
1963	24,654	3,854	1,759	30,267	103,274	29.3
1964	20,648	4,049	1,643	26,340	102,693	25.7
1965	24,043	3,104	2,319	29,466	133,847	22.0
1966	23,491	3,688	2,705	29,884	138,426	21.6
1967	26,753	3,290	2,290	32,333	150,946	21.4
1968	23,902	3,482	8,494	35,878	152,839	23.5
1969	23,519	2,366	3,177	29,062	165,000	17.6
1970	28,913	2,217	3,686	34,816	158,500	22.0
1971	34,774	2,385	5,205	42,364	171,283[c]	24.7

[a]Data are not yet available (November, 1973) for 1972.

[b]Includes food, raw materials of agricultural origin, and inputs for agricultural production.

[c]Estimate of Banco Central de Bolivia.

Source: CONEPLAN, Instituto Nacional de Estadística, Anuario de Comercio Exterior de Bolivia (La Paz: Instituto Nacional de Estadistica, 1951-1970); unpublished data from the División de Estudios Económicos y Estadísticos of the Ministerio de Agricultura y Ganadería for 1971

TABLE B.4. Imports of Principal Food Products, Bolivia 1951-1971

(1,000 Current U.S. Dollars)

Year	Meat	Edible Oils[a]	Lard	Milk Products[b]	Rice	Sugar	Wheat Flour[c]	Other Cereals[d]	Others[e]	Total
1951	1,991	965	1,834	1,409	1,542	6,905	6,052	670	2,965	24,333
1952	3,246	948	2,100	1,972	1,968	5,070	8,336	499	2,723	26,862
1953	3,382	945	1,618	1,275	2,052	5,768	7,945	581	1,754	25,320
1954	2,076	725	1,577	1,685	2,583	4,925	7,422	269	1,723	22,985
1955	4,333	593	1,180	3,725	1,392	4,046	7,007	531	2,088	24,895
1956	5,075	390	682	2,159	1,129	4,148	4,346	884	2,809	21,622
1957	968	1,157	1,746	1,839	1,768	6,557	10,344	610	2,758	27,747
1958	328	609	1,890	488	1,390	3,362	5,527	1,913	1,796	17,303
1959	43	801	1,241	1,152	915	4,278	6,243	190	1,246	16,109
1960	83	680	1,423	1,520	272	2,186	6,113	236	2,304	14,817
1961	211	339	2,488	1,856	524	1,720	9,579	278	2,045	19,040
1962	991	1,220	2,201	1,601	1,306	1,836	11,652	1,507	2,411	24,725
1963	739	892	2,506	3,831	55	886	12,886	270	2,589	24,654
1964	205	1,169	2,774	1,822	2	16	11,187	510	2,963	20,648
1965	173	1,600	2,929	2,360	39	45	13,062	409	3,426	24,043
1966	89	1,202	3,528	1,779	298	8	12,298	712	3,577	23,491
1967	212	946	2,878	2,793	2	--	15,707	325	3,890	26,753
1968	178	1,051	2,849	2,252	7	--	13,514	334	3,717	23,902
1969	177	1,266	2,878	2,816	4	--	12,633	292	3,453	23,519
1970	65	1,069	3,893	3,187	--	--	16,220	619	3,860	28,913
1971	138	2,731	5,832	3,189	--	--	18,278	422	4,184	34,774

[a] Includes vegetable shortening such as crisco as well as edible oils.

[b] Includes fresh, powdered, condensed and evaporated milk, butter and cheese.

[c] Includes wheat and wheat flour.

[d] Includes corn, barley and rye, and flour from these cereals.

[e] Includes any kind of food not defined before.

Source: Same as Table B.3.

TABLE B.5. Imports of Raw Materials of Agriculture Origin,

Bolivia, 1951-1971

(1,000 Current U.S. Dollars)

Year	Cotton	Tobacco	Tallow	Wool[a]	Others[b]	Total
1951	2,258	397	13	1,740	1,036	5,444
1952	1,151	162	32	2,300	395	4,040
1953	1,062	215	294	751	843	3,165
1954	2,082	270	566	694	751	4,363
1955	1,501	244	507	1,954	683	4,889
1956	694	296	271	2,064	581	3,906
1957	1,414	310	213	2,520	573	5,030
1958	2,639	323	184	218	370	3,734
1959	348	368	304	405	177	1,602
1960	5,914	427	120	388	350	7,199
1961	3,341	509	185	305	580	4,920
1962	1,041	675	675	430	292	3,113
1963	1,412	836	836	479	291	3,854
1964	1,536	833	835	485	360	4,049
1965	307	973	953	591	280	3,104
1966	928	842	689	518	711	3,688
1967	224	1,035	836	286	909	3,290
1968	390	1,210	551	289	1,042	3,482
1969	--	631	691	232	812	2,366
1970	2	927	698	393	197	2,217
1971	--	805	455	794	331	2,385

[a]Includes sheep, llama and vicuna wool.

[b]Includes a variety of items such as skin, wool, feather, rubber, etc.

Source: Same as Table B.3.

TABLE B.6. Imports of Inputs for Agriculture, Bolivia, 1951-1971

(1,000 Current U.S. Dollars)

Year	Fertil-izer[a]	Ani-mals	Insec-ticides[b]	Vaccines[c]	Machines & Acces.[d]	Tractors & Acces.[e]	Hand Tools	Seeds	Total
1951	22	253	60	87	--	454	216	--	1,092
1952	--	262	60	66	--	582	126	--	1,096
1953	7	208	100	50	126	590	169	38	1,288
1954	9	23	61	39	59	458	157	25	831
1955	4	47	63	50	213	2,247	134	15	2,773
1956	2	17	73	97	98	5,117	322	30	5,756
1957	5	19	60	111	101	807	252	21	1,376
1958	4	16	79	145	98	930	185	18	1,475
1959	28	14	47	62	52	486	94	18	801
1960	121	44	95	73	21	597	156	77	1,184
1961	68	89	47	36	3	359	197	47	846
1962	93	154	126	62	192	--	232	99	958
1963	204	470	218	64	351	66	242	144	1,759
1964	325	509	136	75	184	104	173	137	1,643
1965	399	655	196	78	228	--	578	185	2,319
1966	971	336	241	86	273	297	319	182	2,705
1967	783	504	334	60	145	181	89	194	2,290
1968	578	860	513	84	401	5,456	375	227	8,474
1969	104	1,105	338	97	805	427	167	134	3,177
1970	1,062	165	590	65	766	590	138	310	3,686
1971	585	270	435	102	1,611	1,686	119	397	5,205

[a]Includes artificial and natural fertilizers.

[b]Includes insecticides, herbicides, and disinfectants.

[c]Include frozen semen, veterinary medicines and instruments.

[d]Includes hay balers, egg selectors, grain cleaners, milking machines, fertilizer mixers, and incubators, etc.

[e]Includes machinery for preparation and working of land.

Source: Same as Table B.3.

TABLE B.7. Trade Balance in Agriculture, 1951-1971

(1,000 U.S. Dollars)

Year	Exports	Imports	Balance
1951	4,195	30,869	-26,674
1952	3,185	31,998	-28,813
1953	2,205	29,773	-27,568
1954	2,447	28,179	-25,732
1955	2,056	32,557	-30,501
1956	3,891	31,284	-27,393
1957	3,595	34,153	-30,558
1958	2,916	22,512	-19,596
1959	5,292	18,512	-13,220
1960	4,344	23,200	-18,856
1961	4,604	24,806	-20,202
1962	4,425	28,796	-24,371
1963	3,943	30,267	-26,324
1964	5,060	26,340	-21,280
1965	5,957	29,466	-23,509
1966	11,857	29,884	-18,027
1967	11,714	32,333	-20,619
1968	7,736	35,878	-28,142
1969	7,530	29,062	-21,532
1970	9,986	34,816	-24,830
1971	17,929	42,364	-24,435

Source: Tables B.1 and B.3.

APPENDIX C:

ESTABLISHMENT OF BOUNDS

Bounds are placed on designated crops and zones in an attempt to compensate for physical characteristics not reflected in the production coefficients. Construction of the bounds is based on the following equation:

% of total 1972 production x % in traditional x
1972 occupied land areas = bound in hectares.

For any given zone, the percentage of total production produced in that zone is obtained from a recent study [20]. Next, estimates of the percentage of total production produced with traditional methods is set for all crops under consideration. Finally, 1972 production figures are taken from a rural production and consumption study for that year [20]. These three firuges are multiplied together to give the value of the bound in hectares.

Setting the bound for minimum rice production in zone 1 will illustrate how all bounds were set. The amount of total production growin in zone 1 for 1972 was 17 percent. Traditional production of rice was figured to be 52.5 percent and total occupied land area was 65,438 hectares. The resulting bound is rounded up to 5,870 hectares to agree with production and yields.

The program required the bounds to be in hectares for the crop activities. Conversion to quantity of production is easily accomplished by multiplying the program bounds by yields of the various crops in their respective zones. Table C.1 lists the bounds established for the lower base, base, and higher base target values along with their corresponding production quantities. All values are lower bounds unless otherwise indicated.

TABLE C.1. Program Bounds by Crop and Zone

Crop	Zone	Computer Run: Lower Base (ha.)	Computer Run: Base (ha.)	Computer Run: Higher Base (ha.)	Yield by Crop per Zone[a] mt/ha	Computer Run: Lower Base (mt.)	Computer Run: Base (ha.)	Computer Run: Higher Base (mt.)
Rice	1	4,990	5,870	6,750	1.51	7,535	8,864	10,193
	2	3,519	4,140	4,760	1.51	5,314	6,251	7,188
	3	2,907	3,420	3,930	1.37	3,983	4,685	5,384
	4	12,267	14,432	16,590	1.7	20,854	24,534	28,203
	5	323	380	437	1.35	436	513	590
	7	4,140	4,870	5,600	1.5	6,210	7,305	8,400
Sugar Cane	1	621	730	840	20	12,420	14,600	16,800
	2	383	450	517	32	12,256	14,400	16,544
	3	800	940	1,080	31	24,800	29,140	33,480
	4	32,810	38,600	44,390	35	1,148,350	1,351,000	1,531,650
	5	1,105	1,300	1,495	34	35,570	44,200	50,830
Pineapple	1	119	140	160	3.0	357	420	480
	2	24	28	32	3.2	77	90	102
	4	56	66	75	3.5	196	231	263
Coffee	1	228	268	300	.56	128	150	168
	2	924	1,087	1,250	.69	638	750	863
	7	15,555	18,300	21,000	.77	11,977	14,091	16,170
Cotton	4	11,594	13,640	15,686	.37	4,290	5,047	5,804
	5	4,930	5,800	6,670	.32	1,578	1,856	2,134
Wheat	6	65,025	76,500	87,975	.60	39,015	45,900	52,785
	7	850*	1,000*	1,150*	.64	544	640	736
	9	30,022	35,320	40,600	.46	13,810	16,247	18,676
Peanuts	4	2,900	3,429	3,900	1.4	4,060	4,801	5,460
	6	1,850	2,180	2,500	.55	1,018	1,199	1,375
Oranges	4	412	485	560	7.5	3,090	3,638	4,200
	5	56	66	75	66.0	3,696	4,356	4,950
Coca Leaf	7[b]	3,570	4,200	3,570	.85	3,035	3,570	3,035
	7[c]	6,290	7,400	6,290	.26	1,635	1,924	1,635
Potatoes	4	204	240	276	8.0	1,632	1,920	2,208
	5	196	230	265	11.0	2,156	2,530	2,915
	6	29,560	34,776	39,990	12.0	354,720	417,312	479,880
	7	765	900	1,035	9.8	7,497	8,820	10,143
	8	3,995	4,700	5,400	4.8	19,176	22,560	25,920
	9	31,450	37,000	42,550	4.8	150,960	177,600	204,240
	10	1,993	2,345	2,690	5.0	9,965	11,725	13,450
Milk Cows	4	8,500*	10,000*	11,500*	3.0[d]	25,500	30,000	34,500
Bananas	7	17,850	21,000	24,150	1.2	21,420	25,200	28,980

*Upper bounds.

[a]All yields taken in traditional technology from Table 3.2.

[b]Chapare variety.

[c]Yungas variety.

[d]Head per hectare.

APPENDIX D:

COEFFICIENTS OF PROGRAM MATRIX

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PROBLEM STATISTICS:     196 ROWS,           503 VARIABLES,
THESE STATISTICS INCLUDE ONE SLACK VARIABLE FOR EACH ROW.

          0 MINOR ERRORS,               0 MAJOR ERRORS.

BCDUUT    TIME--PROCESSOR =     0.13    ELAPSED =     1.42

NAME           MINCOST
ROWS
3171 ELEMENTS, DENSITY =        3.21642 PERCENT
```

N	CUST	L	CAP33	L	LAB59	L	LAB83	E	BEEF
L	LAND11	L	LAB31	L	LAB510	L	LAB84	E	CAFE
L	LAND21	L	LAB32	L	LAND16	L	LAB85	E	YUCA
L	LAND31	L	LAB34	L	LAND36	L	LAB86	E	TABA
L	LAND41	L	LAB35	L	LAND56	L	LAB87	E	COTT
L	LAND51	L	LAB36	L	LAND66	L	LAB89	E	SUYA
L	LAB11	L	LAB37	L	LAB66	L	LAB810	E	PAPA
L	WAT11	L	LAB38	L	WAT66	L	LAND19	E	ORAN
L	FERT11	L	LAB39	L	FERT66	L	LAND59	E	MILKC
L	CAP11	L	LAB310	L	CAP66	L	LAND79	E	MANI
L	LAB12	L	LAND14	L	LAB61	L	LAB99	E	BARB
L	LAB13	L	LAND24	L	LAB62	L	WAT99	E	BARG
L	LAB14	L	LAND34	L	LAB63	L	FERT99	E	WHEAT
L	LAB15	L	LAND44	L	LAB64	L	CAP99	E	QUIN
L	LAB16	L	LAND54	L	LAB65	L	LAB91	E	CUCA
L	LAB17	L	LAND64	L	LAB67	L	LAB92	E	SHEEP
L	LAB18	L	LAB44	L	LAB68	L	LAB93		
L	LAB19	L	WAT44	L	LAB69	L	LAB94		
L	LAB110	L	FERT44	L	LAB610	L	LAB95		
L	LAND12	L	CAP44	L	LAND17	L	LAB96		
L	LAND22	L	LAB41	L	LAND27	L	LAB97		
L	LAND32	L	LAB42	L	LAND47	L	LAB98		
L	LAND42	L	LAB43	L	LAND57	L	LAB910		
L	LAND52	L	LAB45	L	LAB77	L	LAND110		
L	LAB22	L	LAB46	L	WAT77	L	LAND510		
L	WAT22	L	LAB47	L	FERT77	L	LAND710		
L	FERT22	L	LAB48	L	CAP77	L	LAB1010		
L	CAP22	L	LAB49	L	LAB71	L	WAT1010		
L	LAB21	L	LAB410	L	LAB72	L	FERT1010		
L	LAB23	L	LAND15	L	LAB73	L	CAP101		
L	LAB24	L	LAND25	L	LAB74	L	LAB101		
L	LAB25	L	LAND35	L	LAB75	L	LAB102		
L	LAB26	L	LAND45	L	LAB76	L	LAB103		
L	LAB27	L	LAND55	L	LAB78	L	LAB104		
L	LAB28	L	LAB55	L	LAB79	L	LAB105		
L	LAB29	L	WAT55	L	LAB710	L	LAB106		
L	LAB210	L	FERT55	L	LAND18	L	LAB107		
L	LAND13	L	CAP55	L	LAND58	L	LAB108		
L	LAND23	L	LAB51	L	LAND78	L	LAB109		
L	LAND33	L	LAB52	L	LAB88	E	RICE		
L	LAND43	L	LAB53	L	WAT88	E	CORNG		
L	LAND53	L	LAB54	L	FERT88	E	CORNB		
L	LAB33	L	LAB56	L	CAP88	E	CANE		
L	WAT33	L	LAB57	L	LAB81	E	BANA		
L	FERT33	L	LAB58	L	LAB82	E	PINA		

```
COLUMNS
    R01         COST          1467.00000    LAND21          1.00000
    R01         LAB11         1130.00000    CAP11         337.00000
    R01         LAB12         1130.00000    LAB13        1130.00000
    R01         LAB14         1130.00000    LAB15        1130.00000
    R01         LAB16         1130.00000    LAB17        1130.00000
    R01         LAB18         1130.00000    LAB19        1130.00000
    R01         LAB110        1130.00000    RICE            1.51000
    R11         COST           677.00000    LAND21          1.00000
    R11         LAB11          200.00000    WAT11          45.00000
    R11         CAP11          432.00000    LAB12         200.00000
    R11         LAB13          200.00000    LAB14         200.00000
    R11         LAB15          200.00000    LAB16         200.00000
    R11         LAB17          200.00000    LAB18         200.00000
    R11         LAB19          200.00000    LAB110        200.00000
    R11         RICE             1.73000
    R31         COST          1628.00000    LAND21          1.00000
    R31         LAB11          240.00000    WAT11         660.00000
    R31         FERT11         240.00000    CAP11         488.00000
    R31         LAB12          240.00000    LAB13         240.00000
    R31         LAB14          240.00000    LAB15         240.00000
    R31         LAB16          240.00000    LAB17         240.00000
    R31         LAB18          240.00000    LAB19         240.00000
    R31         LAB110         240.00000    RICE            1.83000
    C01         COST           763.00000    LAND11          1.00000
    C01         LAB11          540.00000    CAP11         223.00000
    C01         LAB12          540.00000    LAB13         540.00000
    C01         LAB14          540.00000    LAB15         540.00000
    C01         LAB16          540.00000    LAB17         540.00000
    C01         LAB18          540.00000    LAB19         540.00000
    C01         LAB110         540.00000    CORNG           1.82000
    CA01        COST          2409.00000    LAND31          1.00000
    CA01        LAB11          530.00000    CAP11        1879.00000
    CA01        LAB12          530.00000    LAB13         530.00000
```

CA01	LAB14	530.00000	LAB15	530.00000
CA01	LAB16	530.00000	LAB17	530.00000
CA01	LAB18	530.00000	LAB19	530.00000
CA01	LAB110	530.00000	CANE	20.00000
CA11	COST	5823.00000	LAND31	1.00000
CA11	LAB11	285.00000	CAP11	5538.00000
CA11	LAB12	285.00000	LAB13	285.00000
CA11	LAB14	285.00000	LAB15	285.00000
CA11	LAB16	285.00000	LAB17	285.00000
CA11	LAB18	285.00000	LAB19	285.00000
CA11	LAB110	285.00000	CANE	40.00000
CA31	COST	6278.00000	LAND31	1.00000
CA31	LAB11	285.00000	WAT11	52.00000
CA31	FERT11	480.00000	CAP11	5461.00000
CA31	LAB12	285.00000	LAB13	285.00000
CA31	LAB14	285.00000	LAB15	285.00000
CA31	LAB16	285.00000	LAB17	285.00000
CA31	LAB18	285.00000	LAB19	285.00000
CA31	LAB110	285.00000	CANE	60.00000
B01	COST	1027.00000	LAND41	1.00000
B01	LAB11	895.00000	CAP11	132.00000
B01	LAB12	895.00000	LAB13	895.00000
B01	LAB14	895.00000	LAB15	895.00000
B01	LAB16	895.00000	LAB17	895.00000
B01	LAB18	895.00000	LAB19	895.00000
B01	LAB110	895.00000	BANA	0.97000
P01	COST	1588.00000	LAND41	1.00000
P01	LAB11	773.00000	CAP11	815.00000
P01	LAB12	773.00000	LAB13	773.00000
P01	LAB14	773.00000	LAB15	773.00000
P01	LAB16	773.00000	LAB17	773.00000
P01	LAB18	773.00000	LAB19	773.00000
P01	LAB110	773.00000	PINA	3.00000
P21	COST	2256.00000	LAND41	1.00000
P21	LAB11	803.00000	FERT11	100.00000
P21	CAP11	1353.00000	LAB12	803.00000
P21	LAB13	803.00000	LAB14	803.00000
P21	LAB15	803.00000	LAB16	803.00000
P21	LAB17	803.00000	LAB18	803.00000
P21	LAB19	803.00000	LAB110	803.00000
P21	PINA	3.50000		
BE01	COST	6.29000	LAND51	1.00000
BE01	LAB11	3.56000	CAP11	2.73000
BE01	LAB12	3.56000	LAB13	3.56000
BE01	LAB14	3.56000	LAB15	3.56000
BE01	LAB16	3.56000	LAB17	3.56000
BE01	LAB18	3.56000	LAB19	3.56000
BE01	LAB110	3.56000	BEEF	0.20000
CU01	COST	746.00000	LAND41	1.00000
CU01	LAB11	662.00000	CAP11	84.00000

C001	LAB12	662.00000	LAB13	662.00000
C001	LAB14	662.00000	LAB15	662.00000
C001	LAB16	662.00000	LAB17	662.00000
C001	LAB18	662.00000	LAB19	662.00000
C001	LAB110	662.00000	CAFE	0.56000
C021	COST	886.00000	LAND41	1.00000
C021	LAB11	593.00000	FERT11	100.00000
C021	CAP11	193.00000	LAB12	593.00000
C021	LAB13	593.00000	LAB14	593.00000
C021	LAB15	593.00000	LAB16	593.00000
C021	LAB17	593.00000	LAB18	593.00000
C021	LAB19	593.00000	LAB110	593.00000
C021	CAFE	0.70000		
Y01	COST	2297.00000	LAND11	1.00000
Y01	LAB11	1033.00000	CAP11	1264.00000
Y01	LAB12	1033.00000	LAB13	1033.00000
Y01	LAB14	1033.00000	LAB15	1033.00000
Y01	LAB16	1033.00000	LAB17	1033.00000
Y01	LAB18	1033.00000	LAB19	1033.00000
Y01	LAB110	1033.00000	YUCA	14.00000
TA01	COST	1815.00000	LAND41	1.00000
TA01	LAB11	958.00000	CAP11	857.00000
TA01	LAB12	958.00000	LAB13	958.00000
TA01	LAB14	958.00000	LAB15	958.00000
TA01	LAB16	958.00000	LAB17	958.00000
TA01	LAB18	958.00000	LAB19	958.00000
TA01	LAB110	958.00000	TABA	0.33000
LABF21	COST	14.00000	LAB11	-12.00000
LABF21	LAB21	13.00000		
LABF31	COST	16.00000	LAB11	-12.00000
LABF31	LAB31	13.00000		
LABF41	COST	20.00000	LAB11	-12.00000
LABF41	LAB41	15.00000		
LABF51	COST	21.00000	LAB11	-12.00000
LABF51	LAB51	14.00000		
LABF61	COST	22.00000	LAB11	-12.00000
LABF61	LAB61	13.00000		
LABF71	COST	14.00000	LAB11	-12.00000
LABF71	LAB71	12.00000		
LABF81	COST	14.00000	LAB11	-12.00000
LABF81	LAB81	12.00000		
LABF91	COST	16.00000	LAB11	-12.00000
LABF91	LAB91	12.00000		
LABF101	COST	22.00000	LAB11	-12.00000
LABF101	LAB101	12.00000		
WATD1	COST	1.15000	WAT11	-1.00000
FERTD1	COST	100.00000	FERT11	-100.00000
CAP1	COST	1.15000	CAP11	-1.00000
LDEV11	COST	468.00000	LAND11	-1.00000
LDEV11	LAB11	336.00000	CAP11	132.00000

LDEV11	LAB12	336.00000	LAB13	336.00000
LDEV11	LAB14	336.00000	LAB15	336.00000
LDEV11	LAB16	336.00000	LAB17	336.00000
LDEV11	LAB18	336.00000	LAB19	336.00000
LDEV11	LAB110	336.00000		
LDEV21	COST	468.00000	LAND21	-1.10000
LDEV21	LAB11	336.00000	CAP11	132.00000
LDEV21	LAB12	336.00000	LAB13	336.00000
LDEV21	LAB14	336.00000	LAB15	336.00000
LDEV21	LAB16	336.00000	LAB17	336.00000
LDEV21	LAB18	336.00000	LAB19	336.00000
LDEV21	LAB110	336.00000		
LDEV31	COST	468.00000	LAND31	-1.00000
LDEV31	LAB11	336.00000	CAP11	132.00000
LDEV31	LAB12	336.00000	LAB13	336.00000
LDEV31	LAB14	336.00000	LAB15	336.00000
LDEV31	LAB16	336.00000	LAB17	336.00000
LDEV31	LAB18	336.00000	LAB19	336.00000
LDEV31	LAB110	336.00000		
LDEV41	COST	468.00000	LAND41	-1.00000
LDEV41	LAB11	336.00000	CAP11	132.00000
LDEV41	LAB12	336.00000	LAB13	336.00000
LDEV41	LAB14	336.00000	LAB15	336.00000
LDEV41	LAB16	336.00000	LAB17	336.00000
LDEV41	LAB18	336.00000	LAB19	336.00000
LDEV41	LAB110	336.00000		
LDEV51	COST	12.00000	LAND51	-1.00000
LDEV51	LAB11	12.00000	LAB12	12.00000
LDEV51	LAB13	12.00000	LAB14	12.00000
LDEV51	LAB15	12.00000	LAB16	12.00000
LDEV51	LAB17	12.00000	LAB18	12.00000
LDEV51	LAB19	12.00000	LAB110	12.00000
R02	COST	1503.00000	LAND22	1.00000
R02	LAB22	1164.00000	CAP22	339.00000
R02	LAB21	1164.00000	LAB23	1164.00000
R02	LAB24	1164.00000	LAB25	1164.00000
R02	LAB26	1164.00000	LAB27	1164.00000
R02	LAB28	1164.00000	LAB29	1164.00000
R02	LAB210	1164.00000	RICE	1.51000
R12	COST	1157.00000	LAND22	1.00000
R12	LAB22	228.00000	WAT22	45.00000
R12	CAP22	884.00000	LAB21	228.00000
R12	LAB23	228.00000	LAB24	228.00000
R12	LAB25	228.00000	LAB26	228.00000
R12	LAB27	228.00000	LAB28	228.00000
R12	LAB29	228.00000	LAB210	228.00000
R12	RICE	2.00000		
R32	COST	2051.00000	LAND22	1.00000
R32	LAB22	276.00000	WAT22	325.00000
R32	FERT22	240.00000	CAP22	1210.00000

R32	LAB21	276.00000	LAB23	276.00000
R32	LAB24	276.00000	LAB25	276.00000
R32	LAB26	276.00000	LAB27	276.00000
R32	LAB28	276.00000	LAB29	276.00000
R32	LAB210	276.00000	RICE	2.10000
C02	COST	822.00000	LAND12	1.00000
C02	LAB22	620.00000	CAP22	202.00000
C02	LAB21	620.00000	LAB23	620.00000
C02	LAB24	620.00000	LAB25	620.00000
C02	LAB26	620.00000	LAB27	620.00000
C02	LAB28	620.00000	LAB29	620.00000
C02	LAB210	620.00000	CORNG	1.67000
CA02	COST	2409.00000	LAND32	1.00000
CA02	LAB22	530.00000	CAP22	1879.00000
CA02	LAB21	530.00000	LAB23	530.00000
CA02	LAB24	530.00000	LAB25	530.00000
CA02	LAB26	530.00000	LAB27	530.00000
CA02	LAB28	530.00000	LAB29	530.00000
CA02	LAB210	530.00000	CANE	32.00000
CA12	COST	5823.00000	LAND32	1.00000
CA12	LAB22	285.00000	CAP22	5538.00000
CA12	LAB21	285.00000	LAB23	285.00000
CA12	LAB24	285.00000	LAB25	285.00000
CA12	LAB26	285.00000	LAB27	285.00000
CA12	LAB28	285.00000	LAB29	285.00000
CA12	LAB210	285.00000	CANE	52.00000
CA32	COST	6278.00000	LAND32	1.00000
CA32	LAB22	285.00000	WAT22	52.00000
CA32	FERT22	480.00000	CAP22	5461.00000
CA32	LAB21	285.00000	LAB23	285.00000
CA32	LAB24	285.00000	LAB25	285.00000
CA32	LAB26	285.00000	LAB27	285.00000
CA32	LAB28	285.00000	LAB29	285.00000
CA32	LAB210	285.00000	CANE	72.00000
B02	COST	1020.00000	LAND42	1.00000
B02	LAB22	908.00000	CAP22	112.00000
B02	LAB21	908.00000	LAB23	112.00000
B02	LAB24	908.00000	LAB25	112.00000
B02	LAB26	908.00000	LAB27	112.00000
B02	LAB28	908.00000	LAB29	112.00000
B02	LAB210	908.00000	BANA	3.80000
P02	COST	1854.00000	LAND42	1.00000
P02	LAB22	744.00000	CAP22	1110.00000
P02	LAB21	744.00000	LAB23	744.00000
P02	LAB24	744.00000	LAB25	744.00000
P02	LAB26	744.00000	LAB27	744.00000
P02	LAB28	744.00000	LAB29	744.00000
P02	LAB210	744.00000	PINA	3.20000
P22	COST	2278.00000	LAND42	1.00000
P22	LAB22	504.00000	FERT22	160.00000

P22	CAP22	1614.00000	LAB21	504.00000
P22	LAB23	504.00000	LAB24	504.00000
P22	LAB25	504.00000	LAB26	504.00000
P22	LAB27	504.00000	LAB28	504.00000
P22	LAB29	504.00000	LAB210	504.00000
P22	PINA	3.80000		
BE02	COST	6.29000	LAND52	1.00000
BE02	LAB22	3.56000	CAP22	2.23000
BE02	LAB21	3.56000	LAB23	3.56000
BE02	LAB24	3.56000	LAB25	3.56000
BE02	LAB26	3.56000	LAB27	3.56000
BE02	LAB28	3.56000	LAB29	3.56000
BE02	LAB210	3.56000	BEEF	0.20000
C002	COST	746.00000	LAND42	1.00000
C002	LAB22	662.00000	CAP22	84.00000
C002	LAB21	662.00000	LAB23	662.00000
C002	LAB24	662.00000	LAB25	662.00000
C002	LAB26	662.00000	LAB27	662.00000
C002	LAB28	662.00000	LAB29	662.00000
C002	LAB210	662.00000	CAFE	0.69000
C022	COST	886.00000	LAND42	1.00000
C022	LAB22	593.00000	FERT22	100.00000
C022	CAP22	593.00000	LAB21	593.00000
C022	LAB23	593.00000	LAB24	593.00000
C022	LAB25	593.00000	LAB26	593.00000
C022	LAB27	593.00000	LAB28	593.00000
C022	LAB29	593.00000	LAB210	593.00000
C022	CAFE	0.83000		
Y02	COST	2383.00000	LAND12	1.00000
Y02	LAB22	1119.00000	CAP22	1264.00000
Y02	LAB21	1119.00000	LAB23	1119.00000
Y02	LAB24	1119.00000	LAB25	1119.00000
Y02	LAB26	1119.00000	LAB27	1119.00000
Y02	LAB28	1119.00000	LAB29	1119.00000
Y02	LAB210	1119.00000	YUCA	13.50000
TA02	COST	1320.00000	LAND42	1.00000
TA02	LAB22	755.00000	CAP22	565.00000
TA02	LAB21	755.00000	LAB23	755.00000
TA02	LAB24	755.00000	LAB25	755.00000
TA02	LAB26	755.00000	LAB27	755.00000
TA02	LAB28	755.00000	LAB29	755.00000
TA02	LAB210	755.00000	TABA	0.24000
LABF12	COST	14.00000	LAB12	12.00000
LABF12	LAB22	-13.00000		
LABF32	COST	15.00000	LAB22	-13.00000
LABF32	LAB32	13.00000		
LABF42	COST	17.00000	LAB22	-13.00000
LABF42	LAB42	15.00000		
LABF52	COST	20.00000	LAB22	-13.00000
LABF52	LAB52	14.00000		

LABF62	COST	21.00000	LAB22	-13.00000
LABF62	LAB62	13.00000		
LABF72	COST	14.00000	LAB22	-13.00000
LABF72	LAB72	12.00000		
LABF82	COST	14.00000	LAB22	-13.00000
LABF82	LAB82	12.00000		
LABF92	COST	15.00000	LAB22	-13.00000
LABF92	LAB92	12.00000		
LABF102	COST	21.00000	LAB22	-13.00000
LABF102	LAB102	12.00000		
WATD2	COST	1.15000	WAT22	-1.00000
FERTD2	COST	100.00000	FERT22	-100.00000
CAP2	COST	1.15000	CAP22	-1.00000
LDEV12	COST	496.00000	LAND12	-1.00000
LDEV12	LAB22	364.00000	CAP22	132.00000
LDEV12	LAB21	364.00000	LAB23	364.00000
LDEV12	LAB24	364.00000	LAB25	364.00000
LDEV12	LAB26	364.00000	LAB27	364.00000
LDEV12	LAB28	364.00000	LAB29	364.00000
LDEV12	LAB210	364.00000		
LDEV22	COST	496.00000	LAND22	-1.00000
LDEV22	LAB22	364.00000	CAP22	132.00000
LDEV22	LAB21	364.00000	LAB23	364.00000
LDEV22	LAB24	364.00000	LAB25	364.00000
LDEV22	LAB26	364.00000	LAB27	364.00000
LDEV22	LAB28	364.00000	LAB29	364.00000
LDEV22	LAB210	364.00000		
LDEV32	COST	496.00000	LAND32	-1.00000
LDEV32	LAB22	364.00000	CAP22	132.00000
LDEV32	LAB21	364.00000	LAB23	364.00000
LDEV32	LAB24	364.00000	LAB25	364.00000
LDEV32	LAB26	364.00000	LAB27	364.00000
LDEV32	LAB28	364.00000	LAB29	364.00000
LDEV32	LAB210	364.00000		
LDEV42	COST	496.00000	LAND42	-1.00000
LDEV42	LAB22	364.00000	CAP22	132.00000
LDEV42	LAB21	364.00000	LAB23	364.00000
LDEV42	LAB24	364.00000	LAB25	364.00000
LDEV42	LAB26	364.00000	LAB27	364.00000
LDEV42	LAB28	364.00000	LAB29	364.00000
LDEV42	LAB210	364.00000		
LDEV52	COST	13.00000	LAND52	-1.00000
LDEV52	LAB22	13.00000	LAB21	13.00000
LDEV52	LAB23	13.00000	LAB24	13.00000
LDEV52	LAB25	13.00000	LAB26	13.00000
LDEV52	LAB27	13.00000	LAB28	13.00000
LDEV52	LAB29	13.00000	LAB210	13.00000
RO3	COST	1503.00000	LAND23	1.00000
RO3	LAB33	1164.00000	CAP33	339.00000
RO3	LAB31	1164.00000	LAB32	1164.00000

R03	LAB34	1164.00000	LAB35	1164.00000
R03	LAB36	1164.00000	LAB37	1164.00000
R03	LAB38	1164.00000	LAB39	1164.00000
R03	LAB310	1164.00000	RICE	1.37000
R13	COST	1157.00000	LAND23	1.00000
R13	LAB33	228.00000	WAT33	45.00000
R13	CAP33	884.00000	LAB31	228.00000
R13	LAB32	228.00000	LAB34	228.00000
R13	LAB35	228.00000	LAB36	228.00000
R13	LAB37	228.00000	LAB38	228.00000
R13	LAB39	228.00000	LAB310	228.00000
R13	RICE	1.41000		
R33	COST	2051.00000	LAND23	1.00000
R33	LAB33	276.00000	WAT33	325.00000
R33	FERT33	240.00000	CAP33	1210.00000
R33	LAB31	276.00000	LAB32	276.00000
R33	LAB34	276.00000	LAB35	276.00000
R33	LAB36	276.00000	LAB37	276.00000
R33	LAB38	276.00000	LAB39	276.00000
R33	LAB310	276.00000	RICE	1.51000
C03	COST	822.00000	LAND13	1.00000
C03	LAB33	620.00000	CAP33	202.00000
C03	LAB31	620.00000	LAB32	620.00000
C03	LAB34	620.00000	LAB35	620.00000
C03	LAB36	620.00000	LAB37	620.00000
C03	LAB38	620.00000	LAB39	620.00000
C03	LAB310	620.00000	CORNG	1.26000
CA03	COST	2409.00000	LAND33	1.00000
CA03	LAB33	530.00000	CAP33	1879.00000
CA03	LAB31	530.00000	LAB32	530.00000
CA03	LAB34	530.00000	LAB35	530.00000
CA03	LAB36	530.00000	LAB37	530.00000
CA03	LAB38	530.00000	LAB39	530.00000
CA03	LAB310	530.00000	CANE	31.00000
CA13	COST	5823.00000	LAND33	1.00000
CA13	LAB33	285.00000	CAP33	5538.00000
CA13	LAB31	285.00000	LAB32	285.00000
CA13	LAB34	285.00000	LAB35	285.00000
CA13	LAB36	285.00000	LAB37	285.00000
CA13	LAB38	285.00000	LAB39	285.00000
CA13	LAB310	285.00000	CANE	51.00000
CA33	COST	6278.00000	LAND33	1.00000
CA33	LAB33	285.00000	WAT33	52.00000
CA33	FERT33	480.00000	CAP33	5461.00000
CA33	LAB31	285.00000	LAB32	285.00000
CA33	LAB34	285.00000	LAB35	285.00000
CA33	LAB36	285.00000	LAB37	285.00000
CA33	LAB38	285.00000	LAB39	285.00000
CA33	LAB310	285.00000	CANE	71.00000
COT03	COST	3293.00000	LAND33	1.00000

COT03	LAB33	771.00000	CAP33	2522.00000
COT03	LAB31	771.00000	LAB32	771.00000
COT03	LAB34	771.00000	LAB35	771.00000
COT03	LAB36	771.00000	LAB37	771.00000
COT03	LAB38	771.00000	LAB39	771.00000
COT03	LAB310	771.00000	COTT	0.37000
COT23	COST	3833.00000	LAND33	1.00000
COT23	LAB33	1250.00000	FERT33	80.00000
COT23	CAP33	2503.00000	LAB31	1250.00000
COT23	LAB32	1250.00000	LAB34	1250.00000
COT23	LAB35	1250.00000	LAB36	1250.00000
COT23	LAB37	1250.00000	LAB38	1250.00000
COT23	LAB39	1250.00000	LAB310	1250.00000
COT23	COTT	0.48000		
B03	COST	1020.00000	LAND43	1.00000
B03	LAB33	908.00000	CAP33	112.00000
B03	LAB31	908.00000	LAB32	908.00000
B03	LAB34	908.00000	LAB35	908.00000
B03	LAB36	908.00000	LAB37	908.00000
B03	LAB38	908.00000	LAB39	908.00000
B03	LAB310	908.00000	BANA	0.68000
Y03	COST	2383.00000	LAND13	1.00000
Y03	LAB33	1119.00000	CAP33	1264.00000
Y03	LAB31	1119.00000	LAB32	1119.00000
Y03	LAB34	1119.00000	LAB35	1119.00000
Y03	LAB36	1119.00000	LAB37	1119.00000
Y03	LAB38	1119.00000	LAB39	1119.00000
Y03	LAB310	1119.00000	YUCA	14.00000
S03	COST	1092.00000	LAND33	1.00000
S03	LAB33	120.00000	CAP33	972.00000
S03	LAB31	120.00000	LAB32	120.00000
S03	LAB34	120.00000	LAB35	120.00000
S03	LAB36	120.00000	LAB37	120.00000
S03	LAB38	120.00000	LAB39	120.00000
S03	LAB310	120.00000	SOYA	0.55000
BE03	COST	10.44000	LAND53	1.00000
BE03	LAB33	5.46000	CAP33	4.98000
BE03	LAB31	5.46000	LAB32	5.46000
BE03	LAB34	5.46000	LAB35	5.46000
BE03	LAB36	5.46000	LAB37	5.46000
BE03	LAB38	5.46000	LAB39	5.46000
BE03	LAB310	5.46000	BEEF	0.15000
LABF13	COST	16.00000	LAB13	12.00000
LABF13	LAB33	-13.00000		
LABF23	COST	15.00000	LAB23	13.00000
LABF23	LAB33	-13.00000		
LABR43	COST	16.00000	LAB33	-13.00000
LABR43	LAB43	15.00000		
LABF53	COST	15.00000	LAB33	-13.00000
LABF53	LAB53	14.00000		

LABF63	COST	18.00000	LAB33	-13.00000
LABF63	LAB63	13.00000		
LABF73	COST	16.00000	LAB33	-13.00000
LABF73	LAB73	12.00000		
LABF83	COST	20.00000	LAB33	-13.00000
LABF83	LAB83	12.00000		
LABF93	COST	17.00000	LAB33	-13.00000
LABF93	LAB93	12.00000		
LABF103	COST	18.00000	LAB33	-13.00000
LABF103	LAB103	12.00000		
WATD3	COST	1.15000	WAT33	-1.00000
FERTD3	COST	100.00000	FERT33	-100.00000
CAP3	COST	1.15000	CAP33	-1.00000
LDEV13	COST	492.00000	LAND13	-1.00000
LDEV13	LAB33	364.00000	CAP33	132.00000
LDEV13	LAB31	364.00000	LAB32	364.00000
LDEV13	LAB34	364.00000	LAB35	364.00000
LDEV13	LAB36	364.00000	LAB37	364.00000
LDEV13	LAB38	364.00000	LAB39	364.00000
LDEV13	LAB310	364.00000		
LDEV23	COST	492.00000	LAND23	-1.00000
LDEV23	LAB33	364.00000	CAP33	132.00000
LDEV23	LAB31	364.00000	LAB32	364.00000
LDEV23	LAB34	364.00000	LAB35	364.00000
LDEV23	LAB36	364.00000	LAB37	364.00000
LDEV23	LAB38	364.00000	LAB39	364.00000
LDEV23	LAB310	364.00000		
LDEV33	COST	2102.00000	LAND33	-1.00000
LDEV33	LAB33	91.00000	CAP33	2016.00000
LDEV33	LAB31	91.00000	LAB32	91.00000
LDEV33	LAB34	91.00000	LAB35	91.00000
LDEV33	LAB36	91.00000	LAB37	91.00000
LDEV33	LAB38	91.00000	LAB39	91.00000
LDEV33	LAB310	91.00000		
LDEV43	COST	492.00000	LAND43	-1.00000
LDEV43	LAB33	364.00000	CAP33	132.00000
LDEV43	LAB31	364.00000	LAB32	364.00000
LDEV43	LAB34	364.00000	LAB35	364.00000
LDEV43	LAB36	364.00000	LAB37	364.00000
LDEV43	LAB38	364.00000	LAB39	364.00000
LDEV43	LAB310	364.00000		
LDEV53	COST	13.00000	LAND53	-1.00000
LDEV53	LAB33	13.00000	LAB31	13.00000
LDEV53	LAB32	13.00000	LAB34	13.00000
LDEV53	LAB35	13.00000	LAB36	13.00000
LDEV53	LAB37	13.00000	LAB38	13.00000
LDEV53	LAB39	13.00000	LAB310	13.00000
R04	COST	1523.00000	LAND24	1.00000
R04	LAB44	1164.00000	CAP44	359.00000
R04	LAB41	1164.00000	LAB42	1164.00000

R04	LAB43	1164.00000	LAB45	1164.00000
R04	LAB46	1164.00000	LAB47	1164.00000
R04	LAB48	1164.00000	LAB49	1164.00000
R04	LAB410	1164.00000	RICE	1.70000
R14	COST	1156.00000	LAND24	1.00000
R14	LAB44	228.00000	WAT44	45.00000
R14	CAP44	883.00000	LAB41	228.00000
R14	LAB42	228.00000	LAB43	228.00000
R14	LAB45	228.00000	LAB46	228.00000
R14	LAB47	228.00000	LAB48	228.00000
R14	LAB49	228.00000	LAB410	228.00000
R14	RICE	1.85000		
R34	COST	2051.00000	LAND24	1.00000
R34	LAB44	276.00000	WAT44	325.00000
R34	FERT44	240.00000	CAP44	1210.00000
R34	LAB41	276.00000	LAB42	276.00000
R34	LAB43	276.00000	LAB45	276.00000
R34	LAB46	276.00000	LAB47	276.00000
R34	LAB48	276.00000	LAB49	276.00000
R34	LAB410	276.00000	RICE	1.95000
C04	COST	822.00000	LAND14	1.00000
C04	LAB44	620.00000	CAP44	202.00000
C04	LAB41	620.00000	LAB42	620.00000
C04	LAB43	620.00000	LAB45	620.00000
C04	LAB46	620.00000	LAB47	620.00000
C04	LAB48	620.00000	LAB49	620.00000
C04	LAB410	620.00000	CORNG	1.34000
PA34	COST	3211.00000	LAND14	1.00000
PA34	LAB44	960.00000	WAT44	45.00000
PA34	FERT44	240.00000	CAP44	1666.00000
PA34	LAB41	960.00000	LAB42	960.00000
PA34	LAB43	960.00000	LAB45	960.00000
PA34	LAB46	960.00000	LAB47	960.00000
PA34	LAB48	960.00000	LAB49	960.00000
PA34	LAB410	960.00000	PAPA	8.00000
PA3A4	COST	3363.00000	LAND14	1.00000
PA3A4	LAB44	1425.00000	WAT44	45.00000
PA3A4	FERT44	300.00000	CAP44	1593.00000
PA3A4	LAB41	1425.00000	LAB42	1425.00000
PA3A4	LAB43	1425.00000	LAB45	1425.00000
PA3A4	LAB46	1425.00000	LAB47	1425.00000
PA3A4	LAB48	1425.00000	LAB49	1425.00000
PA3A4	LAB410	1425.00000	PAPA	9.00000
CA04	COST	2409.00000	LAND34	1.00000
CA04	LAB44	530.00000	CAP44	1879.00000
CA04	LAB41	530.00000	LAB42	530.00000
CA04	LAB43	530.00000	LAB45	530.00000
CA04	LAB46	530.00000	LAB47	530.00000
CA04	LAB48	530.00000	LAB49	530.00000
CA04	LAB410	530.00000	CANE	35.00000

CA14	COST	5823.00000	LAND34	1.00000
CA14	LAB44	285.00000	CAP44	5538.00000
CA14	LAB41	285.00000	LAB42	285.00000
CA14	LAB43	285.00000	LAB45	285.00000
CA14	LAB46	285.00000	LAB47	285.00000
CA14	LAB48	285.00000	LAB49	285.00000
CA14	LAB410	285.00000	CANE	85.00000
CA34	COST	6278.00000	LAND34	1.00000
CA34	LAB44	285.00000	WAT44	52.00000
CA34	FERT44	480.00000	CAP44	5461.00000
CA34	LAB41	285.00000	LAB42	285.00000
CA34	LAB43	285.00000	LAB45	285.00000
CA34	LAB46	285.00000	LAB47	285.00000
CA34	LAB48	285.00000	LAB49	285.00000
CA34	LAB410	285.00000	CANE	95.00000
COT04	COST	3293.00000	LAND34	1.00000
COT04	LAB44	771.00000	CAP44	2522.00000
COT04	LAB41	771.00000	LAB42	771.00000
COT04	LAB43	771.00000	LAB45	771.00000
COT04	LAB46	771.00000	LAB47	771.00000
COT04	LAB48	771.00000	LAB49	771.00000
COT04	LAB410	771.00000	COTT	0.37000
COT24	COST	3833.00000	LAND34	1.00000
COT24	LAB44	1250.00000	FERT44	80.00000
COT24	CAP44	2503.00000	LAB41	1250.00000
COT24	LAB42	1250.00000	LAB43	1250.00000
COT24	LAB45	1250.00000	LAB46	1250.00000
COT24	LAB47	1250.00000	LAB48	1250.00000
COT24	LAB49	1250.00000	LAB410	1250.00000
COT24	COTT	0.50000		
B04	COST	1020.00000	LAND44	1.00000
B04	LAB44	908.00000	CAP44	112.00000
B04	LAB41	908.00000	LAB42	908.00000
B04	LAB43	908.00000	LAB45	908.00000
B04	LAB46	908.00000	LAB47	908.00000
B04	LAB48	908.00000	LAB49	908.00000
B04	LAB410	908.00000	BANA	4.70000
CO04	COST	746.00000	LAND44	1.00000
CO04	LAB44	662.00000	CAP44	84.00000
CO04	LAB41	662.00000	LAB42	662.00000
CO04	LAB43	662.00000	LAB45	662.00000
CO04	LAB46	662.00000	LAB47	662.00000
CO04	LAB48	662.00000	LAB49	662.00000
CO04	LAB410	662.00000	CAFE	0.13000
CO24	COST	886.00000	LAND44	1.00000
CO24	LAB44	593.00000	FERT44	100.00000
CO24	CAP44	193.00000	LAB41	593.00000
CO24	LAB42	593.00000	LAB43	593.00000
CO24	LAB45	593.00000	LAB46	593.00000
CO24	LAB47	593.00000	LAB48	593.00000

C024	LAB49	593.00000	LAB410	593.00000
C024	CAFE	0.27000		
P04	COST	1854.00000	LAND44	1.00000
P04	LAB44	744.00000	CAP44	1110.00000
P04	LAB41	744.00000	LAB42	744.00000
P04	LAB43	744.00000	LAB45	744.00000
P04	LAB46	744.00000	LAB47	744.00000
P04	LAB48	744.00000	LAB49	744.00000
P04	LAB410	744.00000	PINA	3.50000
P24	COST	2278.00000	LAND44	1.00000
P24	LAB44	504.00000	FERT44	160.00000
P24	CAP44	1614.00000	LAB41	504.00000
P24	LAB42	504.00000	LAB43	504.00000
P24	LAB45	504.00000	LAB46	504.00000
P24	LAB47	504.00000	LAB48	504.00000
P24	LAB49	504.00000	LAB410	504.00000
P24	PINA	4.40000		
S04	COST	1092.00000	LAND34	1.00000
S04	LAB44	120.00000	CAP44	972.00000
S04	LAB41	120.00000	LAB42	120.00000
S04	LAB43	120.00000	LAB45	120.00000
S04	LAB46	120.00000	LAB47	120.00000
S04	LAB48	120.00000	LAB49	120.00000
S04	LAB410	120.00000	SOYA	0.62000
N04	COST	1739.00000	LAND44	1.00000
N04	LAB44	1562.00000	CAP44	177.00000
N04	LAB41	1562.00000	LAB42	1562.00000
N04	LAB43	1562.00000	LAB45	1562.00000
N04	LAB46	1562.00000	LAB47	1562.00000
N04	LAB48	1562.00000	LAB49	1562.00000
N04	LAB410	1562.00000	ORAN	7.50000
N24	COST	2898.00000	LAND44	1.00000
N24	LAB44	2167.00000	FERT44	80.00000
N24	CAP44	651.00000	LAB41	2167.00000
N24	LAB42	2167.00000	LAB43	2167.00000
N24	LAB45	2167.00000	LAB46	2167.00000
N24	LAB47	2167.00000	LAB48	2167.00000
N24	LAB49	2167.00000	LAB410	2167.00000
N24	ORAN	8.50000		
MC04	COST	976.00000	LAND64	1.00000
MC04	LAB44	219.00000	CAP44	757.00000
MC04	LAB41	219.00000	LAB42	219.00000
MC04	LAB43	219.00000	LAB45	219.00000
MC04	LAB46	219.00000	LAB47	219.00000
MC04	LAB48	219.00000	LAB49	219.00000
MC04	LAB410	219.00000	MILKC	3.00000
BE04	COST	10.44000	LAND54	1.00000
BE04	LAB44	5.46000	CAP44	4.98000
BE04	LAB41	5.46000	LAB42	5.46000
BE04	LAB43	5.46000	LAB45	5.46000

BE04	LAB46	5.46000	LAB47	5.46000
BE04	LAB48	5.46000	LAB49	5.46000
BE04	LAB410	5.46000	BEEF	0.15000
MAN04	COST	1553.00000	LAND34	1.00000
MAN04	LAB44	1032.00000	CAP44	521.00000
MAN04	LAB41	1032.00000	LAB42	1032.00000
MAN04	LAB43	1032.00000	LAB45	1032.00000
MAN04	LAB46	1032.00000	LAB47	1032.00000
MAN04	LAB48	1032.00000	LAB49	1032.00000
MAN04	LAB410	1032.00000	MANI	1.40000
MANOA4	COST	1673.00000	LAND34	1.00000
MANOA4	LAB44	828.00000	CAP44	845.00000
MANOA4	LAB41	828.00000	LAB42	828.00000
MANOA4	LAB43	828.00000	LAB45	828.00000
MANOA4	LAB46	828.00000	LAB47	828.00000
MANOA4	LAB48	828.00000	LAB49	828.00000
MANOA4	LAB410	828.00000	MANI	1.50000
Y04	COST	2555.00000	LAND14	1.00000
Y04	LAB44	1291.00000	CAP44	1264.00000
Y04	LAB41	1291.00000	LAB42	1291.00000
Y04	LAB43	1291.00000	LAB45	1291.00000
Y04	LAB46	1291.00000	LAB47	1291.00000
Y04	LAB48	1291.00000	LAB49	1291.00000
Y04	LAB410	1291.00000	YUCA	14.00000
TAB04	COST	2420.00000	LAND44	1.00000
TAB04	LAB44	1597.00000	CAP44	823.00000
TAB04	LAB41	1597.00000	LAB42	1597.00000
TAB04	LAB43	1597.00000	LAB45	1597.00000
TAB04	LAB46	1597.00000	LAB47	1597.00000
TAB04	LAB48	1597.00000	LAB49	1597.00000
TAB04	LAB410	1597.00000	TABA	0.44000
LABF14	COST	20.00000	LAB14	12.00000
LABF14	LAB44	-15.00000		
LABF24	COST	17.00000	LAB24	13.00000
LABF24	LAB44	-15.00000		
LABF34	COST	16.00000	LAB34	13.00000
LABF34	LAB44	-15.00000		
LABF54	COST	16.00000	LAB44	-15.00000
LABF54	LAB54	14.00000		
LABF64	COST	17.00000	LAB44	-15.00000
LABF64	LAB64	13.00000		
LABF74	COST	17.00000	LAB44	-15.00000
LABF74	LAB74	12.00000		
LABF84	COST	18.00000	LAB44	-15.00000
LABF84	LAB84	12.00000		
LABF94	COST	18.00000	LAB44	-15.00000
LABF94	LAB94	12.00000		
LABF104	COST	19.00000	LAB44	-15.00000
LABF104	LAB104	12.00000		
WATD4	COST	1.15000	WAT44	-1.00000

FERTD4	COST	100.00000	FERT44	-100.00000
CAP4	COST	1.15000	CAP44	-1.00000
LDEV14	COST	552.00000	LAND14	-1.00000
LDEV14	LAB44	420.00000	CAP44	132.00000
LDEV14	LAB41	420.00000	LAB42	420.00000
LDEV14	LAB43	420.00000	LAB45	420.00000
LDEV14	LAB46	420.00000	LAB47	420.00000
LDEV14	LAB48	420.00000	LAB49	420.00000
LDEV14	LAB410	420.00000		
LDEV24	COST	552.00000	LAND24	-1.00000
LDEV24	LAB44	420.00000	CAP44	132.00000
LDEV24	LAB41	420.00000	LAB42	420.00000
LDEV24	LAB43	420.00000	LAB45	420.00000
LDEV24	LAB46	420.00000	LAB47	420.00000
LDEV24	LAB48	420.00000	LAB49	420.00000
LDEV24	LAB410	420.00000		
LDEV34	COST	2121.00000	LAND34	-1.00000
LDEV34	LAB44	105.00000	CAP44	2016.00000
LDEV34	LAB41	105.00000	LAB42	105.00000
LDEV34	LAB43	105.00000	LAB45	105.00000
LDEV34	LAB46	105.00000	LAB47	105.00000
LDEV34	LAB48	105.00000	LAB49	105.00000
LDEV34	LAB410	105.00000		
LDEV44	COST	552.00000	LAND44	-1.00000
LDEV44	LAB44	420.00000	CAP44	132.00000
LDEV44	LAB41	420.00000	LAB42	420.00000
LDEV44	LAB43	420.00000	LAB45	420.00000
LDEV44	LAB46	420.00000	LAB47	420.00000
LDEV44	LAB48	420.00000	LAB49	420.00000
LDEV44	LAB410	420.00000		
LDEV54	COST	15.00000	LAND54	-1.00000
LDEV54	LAB44	15.00000	LAB41	15.00000
LDEV54	LAB42	15.00000	LAB43	15.00000
LDEV54	LAB45	15.00000	LAB46	15.00000
LDEV54	LAB47	15.00000	LAB48	15.00000
LDEV54	LAB49	15.00000	LAB410	15.00000
LDEV64	COST	552.00000	LAND64	-1.00000
LDEV64	LAB44	420.00000	CAP44	132.00000
LDEV64	LAB41	420.00000	LAB42	420.00000
LDEV64	LAB43	420.00000	LAB45	420.00000
LDEV64	LAB46	420.00000	LAB47	420.00000
LDEV64	LAB48	420.00000	LAB49	420.00000
LDEV64	LAB410	420.00000		
R05	COST	1503.00000	LAND25	1.00000
R05	LAB55	1164.00000	CAP44	339.00000
R05	LAB51	1164.00000	LAB52	1164.00000
R05	LAB53	1164.00000	LAB54	1164.00000
R05	LAB56	1164.00000	LAB57	1164.00000
R05	LAB58	1164.00000	LAB59	1164.00000
R05	LAB510	1164.00000	RICE	1.35000

R15	COST	1156.00000	LAND25	1.00000
R15	LAB55	228.00000	WAT55	45.00000
R15	CAP55	885.00000	LAB51	228.00000
R15	LAB52	228.00000	LAB53	228.00000
R15	LAB54	228.00000	LAB56	228.00000
R15	LAB57	228.00000	LAB58	228.00000
R15	LAB59	228.00000	LAB510	228.00000
R15	RICE	1.50000		
R35	COST	2051.00000	LAND25	1.00000
R35	LAB55	276.00000	WAT55	325.00000
R35	FERT55	240.00000	CAP55	1210.00000
R35	LAB51	276.00000	LAB52	276.00000
R35	LAB53	276.00000	LAB54	276.00000
R35	LAB56	276.00000	LAB57	276.00000
R35	LAB58	276.00000	LAB59	276.00000
R35	LAB510	276.00000	RICE	1.61000
C05	COST	822.00000	LAND15	1.00000
C05	LAB55	620.00000	CAP55	202.00000
C05	LAB51	620.00000	LAB52	620.00000
C05	LAB53	620.00000	LAB54	620.00000
C05	LAB56	620.00000	LAB57	620.00000
C05	LAB58	620.00000	LAB59	620.00000
C05	LAB510	620.00000	CORNG	1.19000
PA35	COST	3211.00000	LAND15	1.00000
PA35	LAB55	960.00000	WAT55	45.00000
PA35	FERT44	540.00000	CAP55	1666.00000
PA35	LAB51	960.00000	LAB52	960.00000
PA35	LAB53	960.00000	LAB54	960.00000
PA35	LAB56	960.00000	LAB57	960.00000
PA35	LAB58	960.00000	LAB59	960.00000
PA35	LAB510	960.00000	PAPA	11.00000
PA3A5	COST	3363.00000	LAND15	1.00000
PA3A5	LAB55	1425.00000	WAT55	45.00000
PA3A5	FERT55	300.00000	CAP55	1593.00000
PA3A5	LAB51	1425.00000	LAB52	1425.00000
PA3A5	LAB53	1425.00000	LAB54	1425.00000
PA3A5	LAB56	1425.00000	LAB57	1425.00000
PA3A5	LAB58	1425.00000	LAB59	1425.00000
PA3A5	LAB510	1425.00000	PAPA	13.00000
CA05	COST	2409.00000	LAND35	1.00000
CA05	LAB55	530.00000	CAP55	1879.00000
CA05	LAB51	530.00000	LAB52	530.00000
CA05	LAB53	530.00000	LAB54	530.00000
CA05	LAB56	530.00000	LAB57	530.00000
CA05	LAB58	530.00000	LAB59	530.00000
CA05	LAB510	530.00000	CANE	34.00000
CA15	COST	5823.00000	LAND35	1.00000
CA15	LAB55	285.00000	CAP55	5538.00000
CA15	LAB51	285.00000	LAB52	285.00000
CA15	LAB53	285.00000	LAB54	285.00000

CA15	LAB56	285.00000	LAB57	285.00000
CA15	LAB58	285.00000	LAB59	285.00000
CA15	LAB510	285.00000	CANE	84.00000
CA35	COST	6278.00000	LAND35	1.00000
CA35	LAB55	285.00000	WAT55	52.00000
CA35	FERT55	480.00000	CAP55	5461.00000
CA35	LAB51	285.00000	LAB52	285.00000
CA35	LAB53	285.00000	LAB54	285.00000
CA35	LAB56	285.00000	LAB57	285.00000
CA35	LAB58	285.00000	LAB59	285.00000
CA35	LAB510	285.00000	CANE	94.00000
COT05	COST	3293.00000	LAND35	1.00000
COT05	LAB55	771.00000	CAP55	2522.00000
COT05	LAB51	771.00000	LAB52	771.00000
COT05	LAB53	771.00000	LAB54	771.00000
COT05	LAB56	771.00000	LAB57	771.00000
COT05	LAB58	771.00000	LAB59	771.00000
COT05	LAB510	771.00000	COTT	0.32000
COT25	COST	3833.00000	LAND35	1.00000
COT25	LAB55	1250.00000	FERT55	80.00000
COT25	CAP55	2503.00000	LAB51	1250.00000
COT25	LAB52	1250.00000	LAB53	1250.00000
COT25	LAB54	1250.00000	LAB56	1250.00000
COT25	LAB57	1250.00000	LAB58	1250.00000
COT25	LAB59	1250.00000	LAB510	1250.00000
COT25	COTT	0.36000		
B05	COST	1020.00000	LAND45	1.00000
B05	LAB55	908.00000	CAP55	112.00000
B05	LAB51	908.00000	LAB52	908.00000
B05	LAB53	908.00000	LAB54	908.00000
B05	LAB56	908.00000	LAB57	908.00000
B05	LAB58	908.00000	LAB59	908.00000
B05	LAB510	908.00000	BANA	1.20000
N05	COST	1739.00000	LAND45	1.00000
N05	LAB55	1562.00000	CAP55	177.00000
N05	LAB51	1562.00000	LAB52	1562.00000
N05	LAB53	1562.00000	LAB54	1562.00000
N05	LAB56	1562.00000	LAB57	1562.00000
N05	LAB58	1562.00000	LAB59	1562.00000
N05	LAB510	1562.00000	ORAN	66.00000
N25	COST	2898.00000	LAND45	1.00000
N25	LAB55	2167.00000	FERT55	80.00000
N25	CAP55	651.00000	LAB51	2167.00000
N25	LAB52	2167.00000	LAB53	2167.00000
N25	LAB54	2167.00000	LAB56	2167.00000
N25	LAB57	2167.00000	LAB58	2167.00000
N25	LAB59	2167.00000	LAB510	2167.00000
N25	ORAN	70.00000		
BE05	COST	2.00000	LAND55	1.00000
BE05	LAB55	1.19000	CAP55	0.81000

BE05	LAB51	1.19000	LAB52	1.19000
BE05	LAB53	1.19000	LAB54	1.19000
BE05	LAB56	1.19000	LAB57	1.19000
BE05	LAB58	1.19000	LAB59	1.19000
BE05	LAB510	1.19000	BEEF	0.17000
Y05	COST	2469.00000	LAND15	1.00000
Y05	LAB55	1205.00000	CAP55	1264.00000
Y05	LAB51	1205.00000	LAB52	1205.00000
Y05	LAB53	1205.00000	LAB54	1205.00000
Y05	LAB56	1205.00000	LAB57	1205.00000
Y05	LAB58	1205.00000	LAB59	1205.00000
Y05	LAB510	1205.00000	YUCA	13.50000
LABF15	COST	21.00000	LAB15	12.00000
LABF15	LAB55	-14.00000		
LABF25	COST	20.00000	LAB25	13.00000
LABF25	LAB55	-14.00000		
LABF35	COST	1590.00000	LAB35	13.00000
LABF35	LAB55	-14.00000		
LABF45	COST	16.00000	LAB45	15.00000
LABF45	LAB55	-14.00000		
LABF65	COST	16.00000	LAB55	-14.00000
LABF65	LAB65	13.00000		
LABF75	COST	18.00000	LAB55	-14.00000
LABF75	LAB75	12.00000		
LABF85	COST	21.00000	LAB55	-14.00000
LABF85	LAB85	12.00000		
LAB95	COST	19.00000	LAB55	-14.00000
LAB95	LAB95	12.00000		
LABF105	COST	18.00000	LAB55	-14.00000
LABF105	LAB105	12.00000		
WATD5	COST	1.15000	WAT55	-1.00000
FERTD5	COST	100.00000	FERT55	-100.00000
CAP5	COST	1.15000	CAP55	-1.00000
LDEV15	COST	524.00000	LAND15	-1.00000
LDEV15	LAB55	392.00000	CAP55	132.00000
LDEV15	LAB51	392.00000	LAB52	392.00000
LDEV15	LAB53	392.00000	LAB54	392.00000
LDEV15	LAB56	392.00000	LAB57	392.00000
LDEV15	LAB58	392.00000	LAB59	392.00000
LDEV15	LAB510	392.00000		
LDEV25	COST	524.00000	LAND25	-1.00000
LDEV25	LAB55	392.00000	CAP55	132.00000
LDEV25	LAB51	392.00000	LAB52	392.00000
LDEV25	LAB53	392.00000	LAB54	392.00000
LDEV25	LAB56	392.00000	LAB57	392.00000
LDEV25	LAB58	392.00000	LAB59	392.00000
LDEV25	LAB510	392.00000		
LDEV35	COST	2114.00000	LAND35	-1.00000
LDEV35	LAB55	98.00000	CAP55	2016.00000
LDEV35	LAB51	98.00000	LAB52	98.00000

LDEV35	LAB53	98.00000	LAB54	98.00000
LDEV35	LAB56	98.00000	LAB57	98.00000
LDEV35	LAB58	98.00000	LAB59	98.00000
LDEV35	LAB510	98.00000		
LDEV45	COST	524.00000	LAND45	-1.00000
LDEV45	LAB55	392.00000	CAP55	132.00000
LDEV45	LAB51	392.00000	LAB52	392.00000
LDEV45	LAB53	392.00000	LAB54	392.00000
LDEV45	LAB56	392.00000	LAB57	392.00000
LDEV45	LAB58	392.00000	LAB59	392.00000
LDEV45	LAB510	392.00000		
LDEV55	COST	14.00000	LAND55	-1.00000
LDEV55	LAB55	14.00000	LAB51	14.00000
LDEV55	LAB52	14.00000	LAB53	14.00000
LDEV55	LAB54	14.00000	LAB56	14.00000
LDEV55	LAB57	14.00000	LAB58	14.00000
LDEV55	LAB59	14.00000	LAB510	14.00000
C06	COST	757.00000	LAND16	1.00000
C06	LAB66	540.00000	CAP66	217.00000
C06	LAB61	540.00000	LAB62	540.00000
C06	LAB63	540.00000	LAB64	540.00000
C06	LAB65	540.00000	LAB67	540.00000
C06	LAB68	540.00000	LAB69	540.00000
C06	LAB610	540.00000	CORNG	1.30000
COA6	COST	757.00000	LAND16	1.00000
COA6	LAB66	540.00000	CAP66	217.00000
COA6	LAB61	540.00000	LAB62	540.00000
COA6	LAB63	540.00000	LAB64	540.00000
COA6	LAB65	540.00000	LAB67	540.00000
COA6	LAB68	540.00000	LAB69	540.00000
COA6	LAB610	540.00000	CORNB	3.20000
BAR06	COST	414.00000	LAND16	1.00000
BAR06	LAB66	161.00000	CAP66	253.00000
BAR06	LAB61	161.00000	LAB62	161.00000
BAR06	LAB63	161.00000	LAB64	161.00000
BAR06	LAB65	161.00000	LAB67	161.00000
BAR06	LAB68	161.00000	LAB69	161.00000
BAR06	LAB610	161.00000	BARG	0.61000
BAROA6	COST	414.00000	LAND16	1.00000
BAROA6	LAB66	161.00000	CAP66	253.00000
BAROA6	LAB61	161.00000	LAB62	161.00000
BAROA6	LAB63	161.00000	LAB64	161.00000
BAROA6	LAB65	161.00000	LAB67	161.00000
BAROA6	LAB68	161.00000	LAB69	161.00000
BAROA6	LAB610	161.00000	BARB	2.18000
PA36	COST	2343.00000	LAND16	1.00000
PA36	LAB66	655.00000	WAT66	45.00000
PA36	FERT66	368.00000	CAP66	1275.00000
PA36	LAB61	655.00000	LAB62	655.00000
PA36	LAB63	655.00000	LAB64	655.00000

PA36	LAB65	655.00000	LAB67	655.00000
PA36	LAB68	655.00000	LAB69	655.00000
PA36	LAB610	655.00000	PAPA	12.00000
PA3A6	COST	2744.00000	LAND16	1.00000
PA3A6	LAB66	1068.00000	WAT66	45.00000
PA3A6	FERT66	360.00000	CAP66	1271.00000
PA3A6	LAB61	1068.00000	LAB62	1068.00000
PA3A6	LAB68	1068.00000	LAB69	1068.00000
PA3A6	LAB65	1068.00000	LAB67	1068.00000
PA3A6	LAB63	1068.00000	LAB64	1068.00000
PA3A6	LAB610	1068.00000	PAPA	14.00000
WH06	COST	515.00000	LAND16	1.00000
WH06	LAB66	153.00000	CAP66	362.00000
WH06	LAB61	153.00000	LAB62	153.00000
WH06	LAB63	153.00000	LAB64	153.00000
WH06	LAB65	153.00000	LAB67	153.00000
WH06	LAB68	153.00000	LAB69	153.00000
WH06	LAB610	153.00000	WHEAT	0.60000
WH16	COST	624.00000	LAND16	1.00000
WH16	LAB66	191.00000	WAT66	45.00000
WH16	CAP66	388.00000	LAB61	191.00000
WH16	LAB62	191.00000	LAB63	191.00000
WH16	LAB64	191.00000	LAB65	191.00000
WH16	LAB67	191.00000	LAB68	191.00000
WH16	LAB69	191.00000	LAB610	191.00000
WH16	WHEAT	0.77000		
WH26	COST	1424.00000	LAND16	1.00000
WH26	LAB66	268.00000	FERT66	400.00000
WH26	CAP66	756.00000	LAB61	268.00000
WH26	LAB62	268.00000	LAB63	268.00000
WH26	LAB64	268.00000	LAB65	268.00000
WH26	LAB67	268.00000	LAB68	268.00000
WH26	LAB69	268.00000	LAB610	268.00000
WH26	WHEAT	1.82000		
WH36	COST	1738.00000	LAND16	1.00000
WH36	LAB66	415.00000	WAT66	45.00000
WH36	FERT66	400.00000	CAP66	878.00000
WH36	LAB61	415.00000	LAB62	415.00000
WH36	LAB63	415.00000	LAB64	415.00000
WH36	LAB65	415.00000	LAB67	415.00000
WH36	LAB68	415.00000	LAB69	415.00000
WH36	LAB610	415.00000	WHEAT	2.64000
QU06	COST	515.00000	LAND16	1.00000
QU06	LAB66	153.00000	CAP66	362.00000
QU06	LAB61	153.00000	LAB62	153.00000
QU06	LAB63	153.00000	LAB64	153.00000
QU06	LAB65	153.00000	LAB67	153.00000
QU06	LAB68	153.00000	LAB69	153.00000
QU06	LAB610	153.00000	QUIN	0.78000
MC06	COST	2397.00000	LAND66	1.00000

MC06	LAB66	219.00000	CAP66	2178.00000
MC06	LAB61	219.00000	LAB62	219.00000
MC06	LAB63	219.00000	LAB64	219.00000
MC06	LAB65	219.00000	LAB67	219.00000
MC06	LAB68	219.00000	LAB69	219.00000
MC06	LAB610	219.00000	MILKC	3.00000
BE06	COST	6.29000	LAND16	1.00000
BE06	LAB66	3.56000	CAP66	2.73000
BE06	LAB61	3.56000	LAB62	3.56000
BE06	LAB63	3.56000	LAB64	3.56000
BE06	LAB65	3.56000	LAB67	3.56000
BE06	LAB68	3.56000	LAB69	3.56000
BE06	LAB610	3.56000	BEEF	0.10000
MAN06	COST	1191.00000	LAND36	1.00000
MAN06	LAB66	886.00000	CAP66	305.00000
MAN06	LAB61	886.00000	LAB62	886.00000
MAN06	LAB63	886.00000	LAB64	886.00000
MAN06	LAB65	886.00000	LAB67	886.00000
MAN06	LAB68	886.00000	LAB69	886.00000
MAN06	LAB610	886.00000	MANI	0.55000
MANOA6	COST	1124.00000	LAND36	1.00000
MANOA6	LAB66	240.00000	CAP66	884.00000
MANOA6	LAB61	240.00000	LAB62	240.00000
MANOA6	LAB63	240.00000	LAB64	240.00000
MANOA6	LAB65	240.00000	LAB67	240.00000
MANOA6	LAB68	240.00000	LAB69	240.00000
MANOA6	LAB610	240.00000	MANI	0.63000
Y06	COST	2383.00000	LAND16	1.00000
Y06	LAB66	1119.00000	CAP66	1264.00000
Y06	LAB61	1119.00000	LAB62	1119.00000
Y06	LAB63	1119.00000	LAB64	1119.00000
Y06	LAB65	1119.00000	LAB67	1119.00000
Y06	LAB68	1119.00000	LAB69	1119.00000
Y06	LAB610	1119.00000	YUCA	13.50000
LABF16	COST	22.00000	LAB16	12.00000
LABF16	LAB66	-13.00000		
LABF26	COST	21.00000	LAB26	13.00000
LABF26	LAB66	-13.00000		
LABF36	COST	18.00000	LAB36	13.00000
LABF36	LAB66	-13.00000		
LABF46	COST	17.00000	LAB46	15.00000
LABF46	LAB66	-13.00000		
LABF56	COST	15.00000	LAB56	14.00000
LABF56	LAB66	-13.00000		
LABF76	COST	14.00000	LAB66	-13.00000
LABF76	LAB76	12.00000		
LABF86	COST	15.00000	LAB66	-13.00000
LABF86	LAB86	12.00000		
LABF96	COST	14.00000	LAB66	-13.00000
LABF96	LAB96	12.00000		

LABF106	COST	15.00000	LAB66	-13.00000
LABF106	LAB106	12.00000		
WATD6	COST	1.15000	WAT66	-1.00000
FERTD6	COST	100.00000	FERT66	-100.00000
CAP6	COST	1.15000	CAP66	-1.00000
LDEV16	COST	496.00000	LAND16	-1.00000
LDEV16	LAB66	364.00000	CAP66	132.00000
LDEV16	LAB61	364.00000	LAB62	364.00000
LDEV16	LAB63	364.00000	LAB64	364.00000
LDEV16	LAB65	364.00000	LAB67	364.00000
LDEV16	LAB68	364.00000	LAB69	364.00000
LDEV16	LAB610	364.00000		
LDEV36	COST	496.00000	LAND36	-1.00000
LDEV36	LAB66	364.00000	CAP66	132.00000
LDEV36	LAB61	364.00000	LAB62	364.00000
LDEV36	LAB63	364.00000	LAB64	364.00000
LDEV36	LAB65	364.00000	LAB67	364.00000
LDEV36	LAB68	364.00000	LAB69	364.00000
LDEV36	LAB610	364.00000		
LDEV56	COST	13.00000	LAND56	-1.00000
LDEV56	LAB66	13.00000	LAB61	13.00000
LDEV56	LAB62	13.00000	LAB63	13.00000
LDEV56	LAB64	13.00000	LAB65	13.00000
LDEV56	LAB67	13.00000	LAB68	13.00000
LDEV56	LAB69	13.00000	LAB610	13.00000
LDEV66	COST	13.00000	LAND66	-1.00000
LDEV66	LAB66	13.00000	LAB61	13.00000
LDEV66	LAB62	13.00000	LAB63	13.00000
LDEV66	LAB64	13.00000	LAB65	13.00000
LDEV66	LAB67	13.00000	LAB68	13.00000
LDEV66	LAB69	13.00000	LAB610	13.00000
R07	COST	1457.00000	LAND27	1.00000
R07	LAB77	1120.00000	CAP77	337.00000
R07	LAB71	1120.00000	LAB72	1120.00000
R07	LAB73	1120.00000	LAB74	1120.00000
R07	LAB75	1120.00000	LAB76	1120.00000
R07	LAB78	1120.00000	LAB79	1120.00000
R07	LAB710	1120.00000	RICE	1.50000
R37	COST	968.00000	LAND27	1.00000
R37	LAB77	200.00000	FERT77	240.00000
R37	CAP77	488.00000	LAB71	200.00000
R37	LAB72	200.00000	LAB73	200.00000
R37	LAB74	200.00000	LAB75	200.00000
R37	LAB76	200.00000	LAB78	200.00000
R37	LAB79	200.00000	LAB710	200.00000
R37	RICE	1.70000		
C07	COST	763.00000	LAND17	1.00000
C07	LAB77	540.00000	CAP77	223.00000
C07	LAB71	540.00000	LAB72	540.00000
C07	LAB73	540.00000	LAB74	540.00000

C07	LAB75	540.00000	LAB76	540.00000
C07	LAB78	540.00000	LAB79	540.00000
C07	LAB710	540.00000	CORNG	1.40000
COA7	COST	763.00000	LAND17	1.00000
COA7	LAB77	540.00000	CAP77	223.00000
COA7	LAB71	540.00000	LAB72	540.00000
COA7	LAB73	540.00000	LAB74	540.00000
COA7	LAB75	540.00000	LAB76	540.00000
COA7	LAB78	540.00000	LAB79	540.00000
COA7	LAB710	540.00000	CORNB	12.00000
PA27	COST	3343.00000	LAND17	1.00000
PA27	LAB77	780.00000	FERT77	400.00000
PA27	CAP77	1400.00000	LAB71	780.00000
PA27	LAB72	780.00000	LAB73	780.00000
PA27	LAB74	780.00000	LAB75	780.00000
PA27	LAB76	780.00000	LAB78	780.00000
PA27	LAB79	780.00000	LAB710	780.00000
PA27	PAPA	9.80000		
PA2A7	COST	2670.00000	LAND17	1.00000
PA2A7	LAB77	1240.00000	FERT77	500.00000
PA2A7	CAP77	930.00000	LAB71	1240.00000
PA2A7	LAB72	1240.00000	LAB73	1240.00000
PA2A7	LAB74	1240.00000	LAB75	1240.00000
PA2A7	LAB76	1240.00000	LAB78	1240.00000
PA2A7	LAB79	1240.00000	LAB710	1240.00000
PA2A7	PAPA	11.00000		
WH07	COST	562.00000	LAND17	1.00000
WH07	LAB77	168.00000	CAP77	394.00000
WH07	LAB71	168.00000	LAB72	168.00000
WH07	LAB73	168.00000	LAB74	168.00000
WH07	LAB75	168.00000	LAB76	168.00000
WH07	LAB78	168.00000	LAB79	168.00000
WH07	LAB710	168.00000	WHEAT	0.64000
WH27	COST	1500.00000	LAND17	1.00000
WH27	LAB77	297.00000	FERT77	400.00000
WH27	CAP77	803.00000	LAB71	297.00000
WH27	LAB72	297.00000	LAB73	297.00000
WH27	LAB74	297.00000	LAB75	297.00000
WH27	LAB76	297.00000	LAB78	297.00000
WH27	LAB79	297.00000	LAB710	297.00000
WH27	WHEAT	2.73000		
B07	COST	1024.00000	LAND47	1.00000
B07	LAB77	902.00000	CAP77	122.00000
B07	LAB71	902.00000	LAB72	902.00000
B07	LAB73	902.00000	LAB74	902.00000
B07	LAB75	902.00000	LAB76	902.00000
B07	LAB78	902.00000	LAB79	902.00000
B07	LAB710	902.00000	BANA	0.67000
C007	COST	746.00000	LAND47	1.00000
C007	LAB77	662.00000	CAP77	84.00000

C007	LAB71	662.00000	LAB72	662.00000
C007	LAB73	662.00000	LAB74	662.00000
C007	LAB75	662.00000	LAB76	662.00000
C007	LAB78	662.00000	LAB79	662.00000
C007	LAB710	662.00000	CAFE	0.77000
C027	COST	886.00000	LAND47	1.00000
C027	LAB77	593.00000	FERT77	100.00000
C027	CAP77	193.00000	LAB71	593.00000
C027	LAB72	593.00000	LAB73	593.00000
C027	LAB74	593.00000	LAB75	593.00000
C027	LAB76	593.00000	LAB78	593.00000
C027	LAB79	593.00000	LAB710	593.00000
C027	CAFE	0.87000		
P07	COST	1588.00000	LAND47	1.00000
P07	LAB77	773.00000	CAP77	815.00000
P07	LAB71	773.00000	LAB72	773.00000
P07	LAB73	773.00000	LAB74	773.00000
P07	LAB75	773.00000	LAB76	773.00000
P07	LAB78	773.00000	LAB79	773.00000
P07	LAB710	773.00000	PINA	3.50000
P27	COST	2256.00000	LAND47	1.00000
P27	LAB77	803.00000	FERT77	100.00000
P27	CAP77	1353.00000	LAB71	803.00000
P27	LAB72	803.00000	LAB73	803.00000
P27	LAB74	803.00000	LAB75	803.00000
P27	LAB76	803.00000	LAB78	803.00000
P27	LAB79	803.00000	LAB710	803.00000
P27	PINA	4.00000		
N07	COST	1973.00000	LAND47	1.00000
N07	LAB77	1824.00000	CAP77	149.00000
N07	LAB71	1824.00000	LAB72	1824.00000
N07	LAB73	1824.00000	LAB74	1824.00000
N07	LAB75	1824.00000	LAB76	1824.00000
N07	LAB78	1824.00000	LAB79	1824.00000
N07	LAB710	1824.00000	ORAN	80.00000
N27	COST	2030.00000	LAND47	1.00000
N27	LAB77	1450.00000	FERT77	80.00000
N27	CAP77	500.00000	LAB71	1450.00000
N27	LAB72	1450.00000	LAB73	1450.00000
N27	LAB74	1450.00000	LAB75	1450.00000
N27	LAB76	1450.00000	LAB78	1450.00000
N27	LAB79	1450.00000	LAB710	1450.00000
N27	ORAN	95.00000		
COC07	COST	1034.00000	LAND47	1.00000
COC07	LAB77	108.00000	CAP77	926.00000
COC07	LAB71	108.00000	LAB72	108.00000
COC07	LAB73	108.00000	LAB74	108.00000
COC07	LAB75	108.00000	LAB76	108.00000
COC07	LAB78	108.00000	LAB79	108.00000
COC07	LAB710	108.00000	COCA	0.85000

COCOA7	COST	1018.00000	LAND47	1.00000
COCOA7	LAB77	149.00000	CAP77	869.00000
COCOA7	LAB71	149.00000	LAB72	149.00000
COCOA7	LAB73	149.00000	LAB74	149.00000
COCOA7	LAB75	149.00000	LAB76	149.00000
COCOA7	LAB78	149.00000	LAB79	149.00000
COCOA7	LAB710	149.00000	COCA	0.26000
BE07	COST	6.29000	LAND57	1.00000
BE07	LAB77	3.56000	CAP77	2.73000
BE07	LAB71	3.56000	LAB72	3.56000
BE07	LAB73	3.56000	LAB74	3.56000
BE07	LAB75	3.56000	LAB76	3.56000
BE07	LAB78	3.56000	LAB79	3.56000
BE07	LAB710	3.56000	BEEF	0.20000
YO7	COST	2297.00000	LAND17	1.00000
YO7	LAB77	1033.00000	CAP77	1264.00000
YO7	LAB71	1033.00000	LAB72	1033.00000
YO7	LAB73	1033.00000	LAB74	1033.00000
YO7	LAB75	1033.00000	LAB76	1033.00000
YO7	LAB78	1033.00000	LAB79	1033.00000
YO7	LAB710	1033.00000	YUCA	13.00000
TAO7	COST	16500.00000	LAND47	1.00000
TAO7	LAB77	8712.00000	CAP77	7788.00000
TAO7	LAB71	8712.00000	LAB72	8712.00000
TAO7	LAB73	8712.00000	LAB74	8712.00000
TAO7	LAB75	8712.00000	LAB76	8712.00000
TAO7	LAB78	8712.00000	LAB79	8712.00000
TAO7	LAB710	8712.00000	TABA	3.00000
LABF17	COST	14.00000	LAB17	12.00000
LABF17	LAB77	-12.00000		
LABF27	COST	14.00000	LAB27	13.00000
LABF27	LAB77	-12.00000		
LABF37	COST	16.00000	LAB37	13.00000
LABF37	LAB77	-12.00000		
LAB47	COST	17.00000	LAB47	15.00000
LAB47	LAB77	-12.00000		
LABF57	COST	17.00000	LAB57	14.00000
LABF57	LAB77	-12.00000		
LABF67	COST	14.00000	LAB67	13.00000
LABF67	LAB77	-12.00000		
LABF87	COST	16.00000	LAB77	-12.00000
LABF87	LAB87	12.00000		
LABF97	COST	16.00000	LAB77	-12.00000
LABF97	LAB97	12.00000		
LABF107	COST	18.00000	LAB77	-12.00000
LABF107	LAB107	12.00000		
FERTO7	COST	100.00000	FERT77	-100.00000
CAP7	COST	1.15000	CAP77	-1.00000
LDEV17	COST	468.00000	LAND17	-1.00000
LDEV17	LAB77	336.00000	CAP77	132.00000

LDEV17	LAB71	336.00000	LAB72	336.00000
LDEV17	LAB73	336.00000	LAB74	336.00000
LDEV17	LAB75	336.00000	LAB76	336.00000
LDEV17	LAB78	336.00000	LAB79	336.00000
LDEV17	LAB710	336.00000		
LDEV27	COST	468.00000	LAND27	-1.00000
LDEV27	LAB77	336.00000	CAP77	132.00000
LDEV27	LAB71	336.00000	LAB72	336.00000
LDEV27	LAB73	336.00000	LAB74	336.00000
LDEV27	LAB75	336.00000	LAB76	336.00000
LDEV27	LAB78	336.00000	LAB79	336.00000
LDEV27	LAB710	336.00000		
LDEV47	COST	468.00000	LAND47	-1.00000
LDEV47	LAB77	336.00000	CAP77	132.00000
LDEV47	LAB71	336.00000	LAB72	336.00000
LDEV47	LAB73	336.00000	LAB74	336.00000
LDEV47	LAB75	336.00000	LAB76	336.00000
LDEV47	LAB78	336.00000	LAB79	336.00000
LDEV47	LAB710	336.00000		
LDEV57	COST	12.00000	LAND57	-1.00000
LDEV57	LAB77	12.00000	LAB71	12.00000
LDEV57	LAB72	12.00000	LAB73	12.00000
LDEV57	LAB74	12.00000	LAB75	12.00000
LDEV57	LAB76	12.00000	LAB78	12.00000
LDEV57	LAB79	12.00000	LAB710	12.00000
BAR08	COST	423.00000	LAND1A	1.00000
BAR08	LAB88	170.00000	CAP88	253.00000
BAR08	LAB81	170.00000	LAB82	170.00000
BAR08	LAB83	170.00000	LAB84	170.00000
BAR08	LAB85	170.00000	LAB86	170.00000
BAR08	LAB87	170.00000	LAB89	170.00000
BAR08	LAB810	170.00000	BARG	0.81000
BAROA8	COST	423.00000	LAND1A	1.00000
BAROA8	LAB88	170.00000	CAP88	253.00000
BAROA8	LAB81	170.00000	LAB82	170.00000
BAROA8	LAB83	170.00000	LAB84	170.00000
BAROA8	LAB85	170.00000	LAB86	170.00000
BAROA8	LAB87	170.00000	LAB89	170.00000
BAROA8	LAB810	170.00000	BARB	1.30000
PA38	COST	1935.00000	LAND1A	1.00000
PA38	LAB88	600.00000	FERT8A	200.00000
PA38	CAP88	1135.00000	LAB81	600.00000
PA38	LAB82	600.00000	LAB83	600.00000
PA38	LAB84	600.00000	LAB85	600.00000
PA38	LAB86	600.00000	LAB87	600.00000
PA38	LAB89	600.00000	LAB810	600.00000
PA38	PAPA	4.80000		
PA3A8	COST	2714.00000	LAND1A	1.00000
PA3A8	LAB88	1076.00000	WAT88	45.00000
PA3A8	FERT88	400.00000	CAP88	1193.00000

PA3A8	LAB81	1076.00000	LAB82	1076.00000
PA3A8	LAB83	1076.00000	LAB84	1076.00000
PA3A8	LAB85	1076.00000	LAB86	1076.00000
PA3A8	LAB87	1076.00000	LAB89	1076.00000
PA3A8	LAB810	1076.00000	PAPA	8.00000
QU08	COST	515.00000	LAND1A	1.00000
QU08	LAB88	153.00000	CAP88	362.00000
QU08	LAB81	153.00000	LAB82	153.00000
QU08	LAB83	153.00000	LAB84	153.00000
QU08	LAB85	153.00000	LAB86	153.00000
QU08	LAB87	153.00000	LAB89	153.00000
QU08	LAB810	153.00000	QUIN	0.81000
BE08	COST	10.75000	LAND5A	1.00000
BE08	LAB88	3.69000	CAP88	7.06000
BE08	LAB81	3.69000	LAB82	3.69000
BE08	LAB83	3.69000	LAB84	3.69000
BE08	LAB85	3.69000	LAB86	3.69000
BE08	LAB87	3.69000	LAB89	3.69000
BE08	LAB810	3.69000	BEEF	0.10000
SH08	COST	4.91000	LAND7A	1.00000
SH08	LAB88	3.53000	CAP88	1.38000
SH08	LAB81	3.53000	LAB82	3.53000
SH08	LAB83	3.53000	LAB84	3.53000
SH08	LAB85	3.53000	LAB86	3.53000
SH08	LAB87	3.53000	LAB89	3.53000
SH08	LAB810	3.53000	SHEEP	0.50000
LABF18	COST	14.00000	LAB18	12.00000
LABF18	LAB88	-12.00000		
LABF28	COST	14.00000	LAB28	13.00000
LABF28	LAB88	-12.00000		
LABF38	COST	20.00000	LAB38	13.00000
LABF38	LAB88	-12.00000		
LABF48	COST	18.00000	LAB48	15.00000
LABF48	LAB88	-12.00000		
LABF58	COST	21.00000	LAB58	14.00000
LABF58	LAB88	-12.00000		
LABF68	COST	15.00000	LAB68	13.00000
LABF68	LAB88	-12.00000		
LABF78	COST	16.00000	LAB78	12.00000
LABF78	LAB88	-12.00000		
LABF98	COST	14.00000	LAB88	-12.00000
LABF98	LAB98	12.00000		
LABF108	COST	16.00000	LAB88	-12.00000
LABF108	LAB108	12.00000		
WATD8	COST	1.15000	WAT88	-1.00000
FERTD8	COST	100.00000	FERT8A	-100.00000
CAP8	COST	1.15000	CAP88	-1.00000
LDEV18	COST	468.00000	LAND1A	-1.00000
LDEV18	LAB88	336.00000	CAP88	132.00000
LDEV18	LAB81	336.00000	LAB82	336.00000

LDEV18	LAB83	336.00000	LAB84	336.00000
LDEV18	LAB85	336.00000	LAB86	336.00000
LDEV18	LAB87	336.00000	LAB89	336.00000
LDEV18	LAB810	336.00000		
LDEV58	COST	12.00000	LAND5A	-1.00000
LDEV58	LAB88	12.00000	LAB81	12.00000
LDEV58	LAB82	12.00000	LAB83	12.00000
LDEV58	LAB84	12.00000	LAB85	12.00000
LDEV58	LAB86	12.00000	LAB87	12.00000
LDEV58	LAB89	12.00000	LAB810	12.00000
LDEV78	COST	12.00000	LAND7A	-1.00000
LDEV78	LAB88	12.00000	LAB81	12.00000
LDEV78	LAB82	12.00000	LAB83	12.00000
LDEV78	LAB84	12.00000	LAB85	12.00000
LDEV78	LAB86	12.00000	LAB87	12.00000
LDEV78	LAB89	12.00000	LAB810	12.00000
C09	COST	656.00000	LAND19	1.00000
C09	LAB99	440.00000	CAP99	216.00000
C09	LAB91	440.00000	LAB92	440.00000
C09	LAB93	440.00000	LAB94	440.00000
C09	LAB95	440.00000	LAB96	440.00000
C09	LAB97	440.00000	LAB98	440.00000
C09	LAB910	440.00000	CORNG	0.77000
COA9	COST	656.00000	LAND19	1.00000
COA9	LAB99	440.00000	CAP99	216.00000
COA9	LAB91	440.00000	LAB92	440.00000
COA9	LAB93	440.00000	LAB94	440.00000
COA9	LAB95	440.00000	LAB96	440.00000
COA9	LAB97	440.00000	LAB98	440.00000
COA9	LAB910	440.00000	CORNB	3.00000
BAR09	COST	418.00000	LAND19	1.00000
BAR09	LAB99	165.00000	CAP99	253.00000
BAR09	LAB91	165.00000	LAB92	165.00000
BAR09	LAB93	165.00000	LAB94	165.00000
BAR09	LAB95	165.00000	LAB96	165.00000
BAR09	LAB97	165.00000	LAB98	165.00000
BAR09	LAB910	165.00000	BARG	0.45000
BAROA9	COST	418.00000	LAND19	1.00000
BAROA9	LAB99	165.00000	CAP99	253.00000
BAROA9	LAB91	165.00000	LAB92	165.00000
BAROA9	LAB93	165.00000	LAB94	165.00000
BAROA9	LAB95	165.00000	LAB96	165.00000
BAROA9	LAB97	165.00000	LAB98	165.00000
BAROA9	LAB910	165.00000	BARB	1.90000
PA39	COST	1872.00000	LAND19	1.00000
PA39	LAB99	570.00000	WAT99	251.00000
PA39	CAP99	1051.00000	LAB91	570.00000
PA39	LAB92	570.00000	LAB93	570.00000
PA39	LAB94	570.00000	LAB95	570.00000
PA39	LAB96	570.00000	LAB97	570.00000

PA39	LAB98	570.00000	LAB910	570.00000
PA39	PAPA	4.80000		
PA3A9	COST	2516.00000	LAND19	1.00000
PA3A9	LAB99	974.00000	WAT99	45.00000
PA3A9	FERT99	400.00000	CAP99	1097.00000
PA3A9	LAB91	974.00000	LAB92	974.00000
PA3A9	LAB93	974.00000	LAB94	974.00000
PA3A9	LAB95	974.00000	LAB96	974.00000
PA3A9	LAB97	974.00000	LAB98	974.00000
PA3A9	LAB910	974.00000	PAPA	7.60000
WH09	COST	447.00000	LAND19	1.00000
WH09	LAB99	132.00000	CAP99	315.00000
WH09	LAB91	132.00000	LAB92	132.00000
WH09	LAB93	132.00000	LAB94	132.00000
WH09	LAB95	132.00000	LAB96	132.00000
WH09	LAB97	132.00000	LAB98	132.00000
WH09	LAB910	132.00000	WHEAT	0.46000
WH19	COST	542.00000	LAND19	1.00000
WH19	LAB99	161.00000	WAT99	45.00000
WH19	CAP99	336.00000	LAB91	161.00000
WH19	LAB92	161.00000	LAB93	161.00000
WH19	LAB94	161.00000	LAB95	161.00000
WH19	LAB96	161.00000	LAB97	161.00000
WH19	LAB98	161.00000	LAB910	161.00000
WH19	WHEAT	0.65000		
WH29	COST	1318.00000	LAND19	1.00000
WH29	LAB99	247.00000	FERT99	4000.00000
WH29	CAP99	671.00000	LAB91	247.00000
WH29	LAB92	247.00000	LAB93	247.00000
WH29	LAB94	247.00000	LAB95	247.00000
WH29	LAB96	247.00000	LAB97	247.00000
WH29	LAB98	247.00000	LAB910	247.00000
WH29	WHEAT	0.58000		
WH39	COST	1568.00000	LAND19	1.00000
WH39	LAB99	365.00000	WAT99	45.00000
WH39	FERT99	400.00000	CAP99	758.00000
WH39	LAB91	365.00000	LAB92	365.00000
WH39	LAB93	365.00000	LAB94	365.00000
WH39	LAB95	365.00000	LAB96	365.00000
WH39	LAB97	365.00000	LAB98	365.00000
WH39	LAB910	365.00000	WHEAT	0.78000
QU09	COST	614.00000	LAND19	1.00000
QU09	LAB99	219.00000	CAP99	395.00000
QU09	LAB91	219.00000	LAB92	219.00000
QU09	LAB93	219.00000	LAB94	219.00000
QU09	LAB95	219.00000	LAB96	219.00000
QU09	LAB97	219.00000	LAB98	219.00000
QU09	LAB910	219.00000	QUIN	0.20000
RE09	COST	10.75000	LAND59	1.00000
RE09	LAB99	3.69000	CAP99	7.06000

BE09	LAB91	3.69000	LAB92	3.69000
BE09	LAB93	3.69000	LAB94	3.69000
BE09	LAB95	3.69000	LAB96	3.69000
BE09	LAB97	3.69000	LAB98	3.69000
BE09	LAB910	3.69000	BEEF	0.10000
SH09	COST	4.91000	LAND79	1.00000
SH09	LAB99	3.53000	CAP99	1.38000
SH09	LAB91	3.53000	LAB92	3.53000
SH09	LAB93	3.53000	LAB94	3.53000
SH09	LAB95	3.53000	LAB96	3.53000
SH09	LAB97	3.53000	LAB98	3.53000
SH09	LAB910	3.53000	SHEEP	0.50000
LABF19	COST	16.00000	LAB19	12.00000
LABF19	LAB99	-12.00000		
LABF29	COST	15.00000	LAB29	13.00000
LABF29	LAB99	-12.00000		
LABF39	COST	17.00000	LAB39	13.00000
LABF39	LAB99	-12.00000		
LABF49	COST	18.00000	LAB49	15.00000
LABF49	LAB99	-12.00000		
LABF59	COST	19.00000	LAB59	14.00000
LABF59	LAB99	-12.00000		
LABF69	COST	14.00000	LAB69	13.00000
LABF69	LAB99	-12.00000		
LABF79	COST	16.00000	LAB79	12.00000
LABF79	LAB99	-12.00000		
LABF89	COST	14.00000	LAB89	12.00000
LABF89	LAB99	-12.00000		
LABF109	COST	14.00000	LAB99	-12.00000
LABF109	LAB109	12.00000		
WATD9	COST	1.15000	WAT99	-1.00000
FERTD9	COST	100.00000	FERT99	-100.00000
CAP9	COST	1.15000	CAP99	-1.00000
LDEV19	COST	468.00000	LAND19	-1.00000
LDEV19	LAB99	336.00000	CAP99	132.00000
LDEV19	LAB91	336.00000	LAB92	336.00000
LDEV19	LAB93	336.00000	LAB94	336.00000
LDEV19	LAB95	336.00000	LAB96	336.00000
LDEV19	LAB97	336.00000	LAB98	336.00000
LDEV19	LAB910	336.00000		
LDEV59	COST	12.00000	LAND59	-1.00000
LDEV59	LAB99	12.00000	LAB91	12.00000
LDEV59	LAB92	12.00000	LAB93	12.00000
LDEV59	LAB94	12.00000	LAB95	12.00000
LDEV59	LAB96	12.00000	LAB97	12.00000
LDEV59	LAB98	12.00000	LAB910	12.00000
LDEV79	COST	12.00000	LAND79	-1.00000
LDEV79	LAB99	12.00000	LAB91	12.00000
LDEV79	LAB92	12.00000	LAB93	12.00000
LDEV79	LAB94	12.00000	LAB95	12.00000

LDEV79	LAB96	12.00000	LAB97	12.00000
LDEV79	LAB98	12.00000	LAB910	12.00000
QU010	CUST	674.00000	LAND110	1.00000
QU010	LAB1010	219.00000	CAP101	395.00000
QU010	LAB101	219.00000	LAB102	219.00000
QU010	LAB103	219.00000	LAB104	219.00000
QU010	LAB105	219.00000	LAB106	219.00000
QU010	LAB107	219.00000	LAB108	219.00000
QU010	LAB109	219.00000	QUIN	0.44000
PA210	CUST	1722.00000	LAND110	1.00000
PA210	LAB1010	448.00000	FERT1010	319.00000
PA210	CAP101	955.00000	LAB101	448.00000
PA210	LAB102	448.00000	LAB103	448.00000
PA210	LAB104	448.00000	LAB105	448.00000
PA210	LAB106	448.00000	LAB107	448.00000
PA210	LAB108	448.00000	LAB109	448.00000
PA210	PAPA	5.00000		
PA310	CUST	2385.00000	LAND110	1.00000
PA310	LAB1010	974.00000	WAT1010	45.00000
PA310	FERT1010	400.00000	CAP101	966.00000
PA310	LAB101	974.00000	LAB102	974.00000
PA310	LAB103	974.00000	LAB104	974.00000
PA310	LAB105	974.00000	LAB106	974.00000
PA310	LAB107	974.00000	LAB108	974.00000
PA310	LAB109	974.00000	PAPA	7.00000
BE010	CUST	10.75000	LAND510	1.00000
BE010	LAB1010	3.69000	CAP101	7.06000
BE010	LAB101	3.69000	LAB102	3.69000
BE010	LAB103	3.69000	LAB104	3.69000
BE010	LAB105	3.69000	LAB106	3.69000
BE010	LAB107	3.69000	LAB108	3.69000
BE010	LAB109	3.69000	BEEF	0.10000
SH010	CUST	4.91000	LAND710	1.00000
SH010	LAB1010	3.53000	CAP101	1.38000
SH010	LAB101	3.53000	LAB102	3.53000
SH010	LAB103	3.53000	LAB104	3.53000
SH010	LAB105	3.53000	LAB106	3.53000
SH010	LAB107	3.53000	LAB108	3.53000
SH010	LAB109	3.53000	SHEEP	0.50000
LABF110	CUST	22.00000	LAB110	12.00000
LABF110	LAB1010	-12.00000		
LABF210	CUST	21.00000	LAB210	13.00000
LABF210	LAB1010	-12.00000		
LABF310	CUST	18.00000	LAB310	13.00000
LABF310	LAB1010	-12.00000		
LABF410	CUST	19.00000	LAB410	15.00000
LABF410	LAB1010	-12.00000		
LABF510	CUST	18.00000	LAB510	14.00000
LABF510	LAB1010	-12.00000		
LABF610	CUST	15.00000	LAB610	13.00000

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    LABF610    LAB1010       -12.00000
    LABF710    COST           18.00000    LAB710          12.00000
    LABF710    LAB1010       -12.00000
    LABF810    COST           16.00000    LAB810          12.00000
    LABF810    LAB1010       -12.00000
    LABF910    COST           14.00000    LAB910          12.00000
    LABF910    LAB1010       -12.00000
    WATD10     COST            1.15000    WAT1010         -1.00000
    FERTD10    COST          100.00000    FERT1010      -100.00000
    CAP10      COST            1.15000    CAP101          -1.00000
    LDEV110    COST          468.00000    LAND110         -1.00000
    LDEV110    LAB1010       336.00000    CAP101         132.00000
    LDEV110    LAB101        336.00000    LAB102         336.00000
    LDEV110    LAB103        336.00000    LAB104         336.00000
    LDEV110    LAB105        336.00000    LAB106         336.00000
    LDEV110    LAB107        336.00000    LAB108         336.00000
    LDEV110    LAB109        336.00000
    LDEV510    COST           12.00000    LAND510         -1.00000
    LDEV510    LAB1010        12.00000    LAB101          12.00000
    LDEV510    LAB102         12.00000    LAB103          12.00000
    LDEV510    LAB104         12.00000    LAB105          12.00000
    LDEV510    LAB106         12.00000    LAB107          12.00000
    LDEV510    LAB108         12.00000    LAB109          12.00000
    LDEV710    COST           12.00000    LAND710         -1.00000
    LDEV710    LAB1010        12.00000    LAB101          12.00000
    LDEV710    LAB102         12.00000    LAB103          12.00000
    LDEV710    LAB104         12.00000    LAB105          12.00000
    LDEV710    LAB106         12.00000    LAB107          12.00000
    LDEV710    LAB108         12.00000    LAB109          12.00000
RHS
    RHS1       LAND11      13121.00000    LAND21       10475.00000
    RHS1       LAND31        657.00000    LAND41        2006.00000
    RHS1       LAND51      4.00000E 06    LAB11        1.32120E 08
    RHS1       WAT11      505539.00000    FERT11       1.20000E 06
    RHS1       CAP11       2.40264E 07    LAB12        1.32120E 08
    RHS1       LAB13       1.32120E 08    LAB14        1.32120E 08
    RHS1       LAB15       1.32120E 08    LAB16        1.32120E 08
    RHS1       LAB17       1.32120E 08    LAB18        1.32120E 08
    RHS1       LAB19       1.32120E 08    LAB110       1.32120E 08
    RHS1       LAND12       9194.00000    LAND22        6257.00000
    RHS1       LAND32        404.00000    LAND42        4711.00000
    RHS1       LAND52      2.00000E 06    LAB22        1.25027E 08
    RHS1       WAT22      302573.00000    FERT22       1.20000E 06
    RHS1       CAP22       1.48308E 07    LAB21        1.25027E 08
    RHS1       LAB23       1.25027E 08    LAB24        1.25027E 08
    RHS1       LAB25       1.25027E 08    LAB26        1.25027E 08
    RHS1       LAB27       1.25027E 08    LAB28        1.25027E 08
    RHS1       LAB29       1.25027E 08    LAB210       1.25027E 08
    RHS1       LAND13      16840.00000    LAND23        7286.00000
    RHS1       LAND33       1095.00000    LAND43        2411.00000
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RHS1	LAND53	1.00000E 06	LAB33	1.13712E 08
RHS1	WAT33	368690.00000	FERT33	1.20000E 06
RHS1	CAP33	1.63925E 07	LAB31	1.13712E 08
RHS1	LAB32	1.13712E 08	LAB34	1.13712E 08
RHS1	LAB35	1.13712E 08	LAB36	1.13712E 08
RHS1	LAB37	1.13712E 08	LAB38	1.13712E 08
RHS1	LAB39	1.13712E 08	LAB310	1.13712E 08
RHS1	LAND14	12077.00000	LAND24	30234.00000
RHS1	LAND34	32193.00000	LAND44	13543.00000
RHS1	LAND54	1.00000E 06	LAND64	4000.00000
RHS1	LAB44	2.75468E 08	WAT44	2.05481E 06
RHS1	FERT44	1.20000E 06	CAP44	8.78845E 07
RHS1	LAB41	2.75468E 08	LAB42	2.75468E 08
RHS1	LAB43	2.75468E 08	LAB45	2.75468E 08
RHS1	LAB46	2.75468E 08	LAB47	2.75468E 08
RHS1	LAB48	2.75468E 08	LAB49	2.75468E 08
RHS1	LAB410	2.75468E 08	LAND15	132083.00000
RHS1	LAND25	479.00000	LAND35	2478.00000
RHS1	LAND45	1897.00000	LAND55	900000.00000
RHS1	LAB55	2.36389E 08	WAT55	97092.00000
RHS1	FERT55	1.20000E 06	CAP55	3.54023E 07
RHS1	LAB51	2.36389E 08	LAB52	2.36389E 08
RHS1	LAB53	2.36389E 08	LAB54	2.36389E 08
RHS1	LAB56	2.36389E 08	LAB57	2.36389E 08
RHS1	LAB58	2.36389E 08	LAB59	2.36389E 08
RHS1	LAB510	2.36389E 08	LAND16	413678.00000
RHS1	LAND36	100.00000	LAND56	2.00000E 06
RHS1	LAND66	8000.00000	LAB66	2.57069E 09
RHS1	WAT66	8.91234E 06	FERT66	1.20000E 06
RHS1	CAP66	2.31527E 08	LAB61	2.57069E 09
RHS1	LAB62	2.57069E 09	LAB63	2.57069E 09
RHS1	LAB64	2.57069E 09	LAB65	2.57069E 09
RHS1	LAB67	2.57069E 09	LAB68	2.57069E 09
RHS1	LAB69	2.57069E 09	LAB610	2.57069E 09
RHS1	LAND17	30271.00000	LAND27	9998.00000
RHS1	LAND47	73562.00000	LAND57	3.00000E 06
RHS1	LAB77	3.01318E 08	WAT77	25200.00000
RHS1	FERT77	1.20000E 06	CAP77	6.65754E 07
RHS1	LAB71	3.01318E 08	LAB72	3.01318E 08
RHS1	LAB73	3.01318E 08	LAB74	3.01318E 08
RHS1	LAB75	3.01318E 08	LAB76	3.01318E 08
RHS1	LAB78	3.01318E 08	LAB79	3.01318E 08
RHS1	LAB710	3.01318E 08	LAND18	32189.00000
RHS1	LAND58	500000.00000	LAND78	220000.00000
RHS1	LAB88	3.50406E 08	WAT88	615405.00000
RHS1	FERT88	1.20000E 06	CAP88	2.45334E 07
RHS1	LAB81	3.20406E 08	LAB82	3.50406E 08
RHS1	LAB83	3.20406E 08	LAB84	3.50406E 08
RHS1	LAB85	3.20406E 08	LAB86	3.50406E 08
RHS1	LAB87	3.20406E 08	LAB89	3.50406E 08

RHS1	LAB810	3.20406E 08	LAND19	324474.00000
RHS1	LAND59	500000.00000	LAND79	1.40000E 06
RHS1	LAB99	1.31544E 09	WAT99	6.94292E 06
RHS1	FERT99	1.20000E 06	CAP99	1.84856E 08
RHS1	LAB91	1.31544E 09	LAB92	1.31544E 09
RHS1	LAB93	1.31544E 09	LAB94	1.31544E 09
RHS1	LAB95	1.31544E 09	LAB96	1.31544E 09
RHS1	LAB97	1.31544E 09	LAB98	1.31544E 09
RHS1	LAB910	1.31544E 09	LAND110	17648.00000
RHS1	LAND510	400000.00000	LAND710	220000.00000
RHS1	LAB1010	1.08621E 08	WAT1010	326880.00000
RHS1	FERT1010	1.20000E 06	CAP101	1.41662E 07
RHS1	LAB101	1.08621E 08	LAB102	1.08621E 08
RHS1	LAB103	1.08621E 08	LAB104	1.08621E 08
RHS1	LAB105	1.08621E 08	LAB106	1.08621E 08
RHS1	LAB107	1.08621E 08	LAB108	1.08621E 08
RHS1	LAB109	1.39655E 08	RICE	91233.00000
RHS1	CORNG	542400.00000	CORNB	10000.00000
RHS1	CANE	2.97119E 06	BANA	317542.00000
RHS1	PINA	1000.00000	BEEF	5.24437E 06
RHS1	CAFE	15000.00000	YUCA	336055.00000
RHS1	TABA	500.00000	COTT	50000.00000
RHS1	SOYA	14000.00000	PAPA	999135.00000
RHS1	ORAN	72676.00000	MILKC	257628.00000
RHS1	MANI	6000.00000	BARB	242013.00000
RHS1	BARG	95473.00000	WHEAT	378348.00000
RHS1	QUIN	72000.00000	COCA	5498.00000
RHS1	SHEEP	3.18465E 06		

APPENDIX E:

CONVERSION CHART OF WEIGHTS AND MEASURES

Metric to U.S. and British Units

From	To	Multiply by
	LENGTH	
centimeters	inches	0.3937
decimeters	inches	3.9370
dekameters	feet	32.8084
hectometers	feet	328.0840
kilometers	nautical miles	0.5400
kilometers	statute miles	0.6214
meters	feet	3.2808
meters	inches	39.3701
meters	yards	1.0936
millimeters	inches	0.0394
	AREA	
square centimeters	square inches	0.1550
square decimeters	square inches	15.5000
square dekameters[4]	acres	0.0247
square dekameters[4]	square rods	3.9537
square hectometers[2]	acres	2.4711
square kilometers	acres	247.1055
square kilometers	square miles	0.3861
square meters[3]	square feet	10.7639
square meters[3]	square yards	1.1960
square millimeters	square inches	0.0016
	VOLUME	
cubic centimeters	cubic inches	0.0610
cubic decimeters	cubic inches	61.0237
cubic meters	cubic feet	35.3147
cubic meters	cubic yards	1.3080
cubic millimeters	cubic inches	0.0001
	CAPACITY (LIQUID MEASURE)	
centiliters	fluid ounces	0.3382
deciliters	fluid ounces	3.3815
dekaliters	gallons (U.S.)	2.6418
hectoliters	gallons (U.S.)	26.4178
liters	gallons (British)	0.2200
liters	gallons (U.S.)	0.2642
liters	quarts (U.S.)	1.0567
milliliters	fluid ounces	0.0338
	CAPACITY (DRY MEASURE)	
centiliters	pints (British)	0.0024
centiliters	pints (U.S.)	0.0182
decaliters	pints (U.S.)	0.1816
dekaliters	pecks (U.S.)	1.1351
hectoliters	bushels (British)	2.7497
hectoliters	bushels (U.S.)	2.8378
liters	quarts (British)	0.9372
liters	quarts (U.S.)	0.9081
milliliters	pints (U.S.)	0.0018
	MASS	
centigrams	grains	0.1543
decigrams	grains	1.5432
dekagrams	ounces, apothecaries and troy	0.3215
dekagrams	ounces, avoirdupois	0.3527
grams	ounces, apothecaries and troy	0.0322
grams	ounces, avoirdupois	0.0353
hectograms	ounces, apothecaries and troy	3.2151
hectograms	ounces, avoirdupois	3.5274
kilograms	pounds, apothecaries and troy	2.6792
kilograms	pounds, avoirdupois	2.2046
metric tons[5]	long tons	0.9842
metric tons[5]	short tons	1.1023
milligrams	grains	0.0154

[2] Also called hectares.

[3] Also called centares.

[4] Also called ares.

[5] Also called milliers and tonnes.

VITA

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Candidate for the Degree of

Master of Science

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Major Field: Agricultural Economics

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